THE

ELECTRICAL REVIEW.

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THE

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THE BURNING QUESTION.

IN our issue of November 11th we called attention to several points in connection with the working of the Shoreditch combined destructor and electricity undertaking, which we considered of vital importance.

We stated that the average amount of refuse burned during the first nine months of working appeared to be 6·7 tons per cell per 24 hours; that the actual wages paid to stokers, apart from the labour of firing up with coal on Sundays, was approximately 1s. 5d. per ton of refuse burned, and the cost of management was about 7d. per ton burned, making the labour and management together nearly 2s. per ton, as against the statement of the chairman of the Electric Lighting Committee at the opening ceremony that the actual total cost of burning, including all charges, came to 1s. 2d. a ton.

We said it would be interesting to know how that figure was ascertained. Mr. Kershaw has now told us, in his speech at the Vestry meeting, that his figures at the opening ceremony had proved to be erroneous, but that they were based upon information supplied by the contractors.

He has also been good enough to write a letter which appeared in our issue of November 18th, in which he convicts us of several "gross blunders." The first of these is, that we called him an official of the Vestry. This point is hardly worth debating, but we fear that officials generally will not feel flattered by Mr. Kershaw's indignation. If we had called him an electrical expert, he could hardly have shown more annoyance. Our second gross blunder was our reference to Mr. Baker's scheme, as having been submitted when public tenders were invited. Mr. Kershaw denies the correctness of this, but we fail to see how it affects the controversy. Thirdly, he says, it is not true that the Blackheath and Greenwich Company has decided against a combined scheme.

We are exceedingly pleased to hear that Mr. Kershaw is, after all, not debarred from a further exercise of his talents in connection with that undertaking, and it seems probable that if a similar scheme to the one at Shoreditch be adopted they will have full scope. We may say that we have not accused Mr. Kershaw, as he implies, of an intention to shield the scheme and the contractors at the expense of truth; though he virtually accuses himself of inconsistency by referring to his opinions, privately expressed, for his justification.

A man in his position ought to be able to reconcile his private opinions with those he has uttered publicly. It is unfortunate that Mr. Kershaw should have allowed himself, by overmuch enthusiasm for a public undertaking, to become the mouthpiece for misleading statements, and prophecies, and ridiculous praises of an unsatisfactory trading account.

How is it that the contractors do not defend themselves from the charge of putting incorrect statements into Mr. Kershaw's mouth? The only contribution to this contro-

versy which we have seen from them is a letter published in several of our contemporaries denying that they offered to buy Mr. Baker's patents. They very naturally resent Mr. Baker's interference, and excuse themselves for entering into the correspondence respecting the figures on the ground that the consulting engineers and the authorities connected with the scheme "most fully admit that the results which they promised have been attained, and much more than attained." This statement does not tally with Mr. Kershaw's. We should like to know what the contractors actually did promise. If, as they state, they promised less than they have performed, we can only say that they got the contract on very easy terms.

Throughout the controversy we have noticed a tendency on each side to claim a victory upon the simple question as to whether or not a profit has been made upon the first year's working. The Committee have persuaded themselves and the Vestry that there is a profit, and are proceeding to allocate it. But that is, after all, not sufficient to determine the engineering questions involved.

Shoreditch is fortunate in having a heavy day load, and even if there is a profit there can be no doubt that it ought to be much larger. To take two points only, we can never admit that the undertaking is a success while the generous allowance of 2s. per ton of refuse burned proves insufficient to meet the cost of destruction and disposal of clinker; and while 40 per cent. of the electricity generated disappears in working the plant and distribution losses. And, moreover, we shall never feel that perfection has been attained while such financial shifts are resorted to as the payment of £1,435 out of the general rates in respect of the charge for interest and repayment of capital on the destructor, while at the same time profits are being declared. It is exceedingly like paying out of one pocket into the other.

It was freely stated at the meeting that instead of there being a saving of 1s. 1d. per ton in the scavenging department, the cost was actually higher than on the barging system. We are anxious to believe that a large portion of the saving has been taken up by more thorough scavenging; and, if so, the money has been laid out to the best possible advantage; but Mr. Kershaw admitted that the lifts were insufficient, and that the carts had to wait far too long to discharge. This appears to be in the way to be remedied by the addition of more lifts.

To come now to the accounts for the first complete year's working, we may say that they fully justify our remarks on November 11th, in which we appear to have understated the costs of working. It seems that the cost per ton for destruction, for labour, and management, works out for the whole year at 2s. 5d. per ton, instead of 2s. This does not include removal of clinker.

We regret to see that the electricity station and destructor are treated as two separate undertakings, and that further transactions "out of one pocket into the other" are thereby rendered possible.

A sale of current to the dust destructor, amounting to £536, is credited to the electricity undertaking, and also the engineer's salary is "proportioned" at £145, the balance being debited to the destructor. What that balance is does not appear, as it is lumped with other items in the destructor account. Further, the destructor is not credited with anything for the supply of steam to the electricity department.

To arrive at the facts we will ignore payments "out of one pocket into the other," and take the actual payments and receipts of the two undertakings as a combined scheme. We then find that the receipts are as follows:—

ELECTRICITY ACCOUNT.

Cr.	£ s. d.	
To Sale of current outside the works ...	8,254 2 1	
„ Miscellaneous receipts	120 4 7	
„ Sale of stores	130 8 4	
		£8,504 15 0

DESTRUCTOR ACCOUNT.

Cr.	£ s. d.	
To Burning trade refuse...	238 1 9	
„ Charged to Scavenging Department —2s. per ton on 23,137 tons ...	2,313 14 0	
		£2,551 15 9
		£11,056 10 9

ELECTRICITY ACCOUNT.

Dr.	£ s. d.	
By Payments, coal, water, stores, salaries, &c....	3,214 14 7	
„ Interest and redemption	2,641 16 2	
		£5,856 10 9

DESTRUCTOR ACCOUNT.

Dr.	£ s. d.	
By Wages	2,829 8 3	
„ Stores	130 8 1	
„ Carting clinker	612 10 5	
„ Insurance	43 4 2	
„ Sundries	217 13 8	
„ Interest and repayment of capital, charged to general rate	1,435 13 4	
		£5,268 17 11
Total Dr. ...		£11,125 8 8
Total Cr. ...		11,056 10 9
Net loss ...		£68 17 11

This shows an excess of expenditure over receipts of £68 17s. 11d., without allowing anything towards the heavy renewals upon the furnaces, boilers and machinery, which, as we pointed out in our former article, will fall due in from 10 to 15 years.

The assumption made in the accounts that none of these things will have to be replaced for 42 years is so extraordinary, that it seems hard to believe that it is sincere; no wonder the Vestry's accountant was instructed not to make any alterations in the accounts submitted to him.

There can be no doubt that if proper allowances were made for repairs and depreciation, the small profit shown by reckoning on the (fictitious) saving to the rates by using the destructor instead of barging, would disappear, and that in reality there is no profit as yet upon the undertaking. The profit has been arrived at by making no proper allowances for depreciation and repairs, which we roughly estimate at £2,000, by charging £1,435 13s. 4d. for interest and repayment of capital on the destructor, to the general rates, and further by taking credit for an imaginary saving of £1,253 on the old system of scavenging, making a total of over £4,600, which has been "hocussed" out of the accounts.

It may be said that it is not fair to discredit the saving on the old system of barging, because the money has actually gone in better scavenging, but we are bound to regard the 2s. a ton as ample payment for destruction, particularly in view of the fact that the South London Company are pledged to burn refuse on the same lines for 11½d. per ton paid to them by the Lambeth Vestry. The results at Shoreditch might have been very different if the cost of labour and management had been (as in other places) under 1s. per ton, and if, as is the case elsewhere, the destructor had been worked without

labour saving machinery. The saving in labour and management at 1s. 5d. per ton, on 23,137 tons would have been £1,639, and we estimate the saving in electricity for driving the tipping waggons, &c., as at least 60,000 units at 1d., or, say, £250. This would leave 68,708 units out of the electricity debited to the destructor for driving fans and other useful machinery and for lighting the destructor works. There would have been a saving in management, and, further, a saving in capital charges of something like £300 a year. Altogether we have come to the conclusion that at least £2,000 a year is being lost in worthless fads.

Were these removed and the plant remodelled on common-sense lines, we feel sure that Mr. Kershaw would soon find a solid basis for his enthusiasm, and that his original prophecies might come somewhere near the truth. But if matters go on as at present we shall not have to wait long for a serious disillusionment which may put "back the clock" for years.

LONG DISTANCE TRANSMISSION OF ELECTRIC POWER.

In his paper on the above subject, the reproduction of which is concluded in our present issue, Prof. Forbes informed us that he was bringing forward nothing new, and then he proceeded to talk of transmitting electric power to a distance of 400 miles, with a maximum pressure of 20,000 volts, by a line which would absorb 90 per cent. of the total capital expenditure; and to talk of this scheme in a matter of fact way which almost made us wonder whether we had been indulging in a Rip Van Winkle sleep whilst electrical engineers and financiers had been between them carrying out transmission power schemes to distances which were not even hinted at in the technical papers when we last saw them. When, however, we have got over our first surprise, and begin to consider the question from the point of view insisted on by Prof. Forbes, viz., that it is all a question of balancing expenditure and revenue, we recognise that if the latter can be obtained at the rate of £100 per annum for each horse-power continuously delivered, there is a margin for paying interest on a very large amount of copper; and that not only with the help of water-power, but also if steam power be used at the generating station. It must not be forgotten, however, that such a rate of payment per horse-power per year implies a very high price for fuel at or near the spot where the power is required, and that as the conditions may be altogether changed by the discovery of new coal fields or by the provision of greater facilities for transport, there is here a risk which must be taken into consideration by financiers in fixing what would be an adequate return for the use of their capital.

What to many people will be a novelty in the paper, is the financial arrangement Prof. Forbes proposes with a view of diminishing the capital required by those who would transmit the power. The example given by the author of the paper supposes a net profit of 9 per cent. on the £320,000 capital invested, and this, he suggests, might be considered an insufficient return by the financier. He therefore proposes to divide the capital into two parts, one of £270,000, representing the value of the copper wire in the line, and the other of £50,000, representing the cost of plant and of erecting the line. He says that the copper may be taken away if the venture is not a success, and that it is an absolutely safe security, and he therefore proposes to raise a mortgage on the £270,000, and considers that 4 per cent. ought to cover the chances of a change of market value. By getting this large proportion of the capital for 4 per cent., he is able to hold out the prospect of 40 per cent. on the £50,000, which is the capital proper of the company. We must say that we fail to see how, if 9 per cent. on the whole capital is not a sufficient return for the financier, this latter, whether copper merchant or not, can be satisfied by a 4 per cent. mortgage on the copper; as, in case of failure, the value of the copper as a realisable asset will not be changed by the method of raising the money.

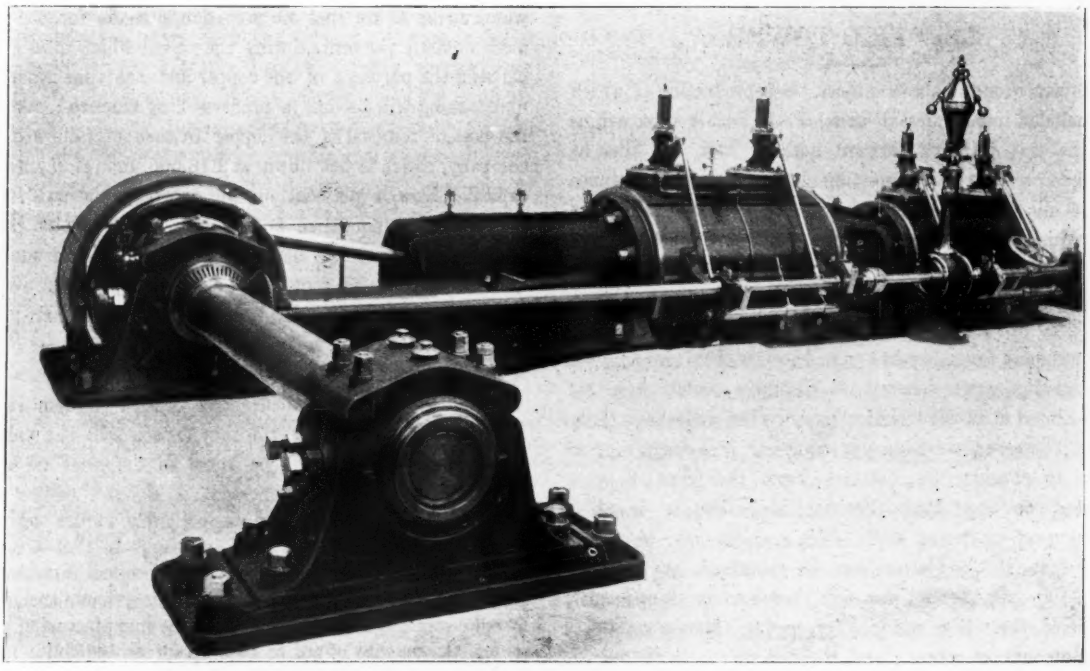
Prof. Forbes backs up his proposal by informing us that the manager of one of the largest copper companies entirely approves of its general lines, but we think that when the details are considered the copper companies will not agree with Prof. Forbes that 4 per cent. is a sufficient return. Some points which strike us are that no provision is made for the payment of the 4 per cent. during the period which must elapse between the purchase of the copper and the time when the undertaking will become a profit-earning concern; and that the cost of removal of the copper in case of failure of the company, which is put down at £18,000, figures as uncalled capital. Now, 4 per cent. on the mortgage means £10,800 per annum, or more than 20 per cent. on the capital proper of the company, and to make provision for this for one year and for the cost of removal of the copper would require that the capital of the company be increased nearly 60 per cent. Again, supposing that the mortgagees obtain adequate securities for the payment of the 4 per cent., and for the copper being returned free of cost to them in case of failure of the venture, can they expect that the value of this returned copper will be equal to the price originally obtained for it? If the mortgagees are not copper merchants, they must buy the copper wire at its ordinary market selling price, and it is quite certain that they will not be able to sell it back again to the copper merchants at the same figure. And if the copper merchants themselves are the mortgagees, and are to make no manufacturing profit out of it, can they afford to lock up for an indefinite period a large part of their working capital for a return of 4 per cent? Even when the copper is returned to them, it is probable that they would have to re-draw it before they could dispose of it. It appears to us that, if a mortgage can be raised on the copper, it will only be on the value of the raw material at the price which the wire drawer would have to pay for it; and that the capital of the company will have to be increased, so as to pay in cash the difference between the cost price of the raw material and the selling price of the copper wire.

Turning from financial questions to the technical part of the paper, we must congratulate Prof. Forbes on the very convenient curves and tables which he publishes for calculating the most economical inefficiency (we wish he could suggest some nicer name for this ratio of input to output), and the corresponding weights of copper per horse-power delivered, and current density in the conductors; and we hope that he will still further increase their usefulness by publishing, in convenient form, some data as to the corrections that must be made to them, when applying them to alternating current circuits of different frequencies and lengths.

SULZER STEAM ENGINES FOR ELECTRIC INSTALLATIONS.

This economical type of steam engine is much better known on the Continent than in England. It is very largely used for mill motors where great economy is required, and also for all kinds of electric installations, and few engines are so much in request. Made by the firm of Sulzer Bros., at Winterthur, the largest engineering firm in Switzerland, it has for many years taken rank as one of the best of modern steam engines. Sulzer engines are now at work in many countries all over the world, and even in Russia, where the duty on foreign machinery is almost prohibitive, manufacturers prefer them to those of home production.

The engines are always made double acting with one, two, or three cylinders, generally horizontal, but sometimes vertical, to save space, as at the Berlin electrical station and elsewhere. They are, of course, constructed condensing or non-condensing, and work with air, jet, or surface condenser, according to local facilities or difficulties in obtaining cheap water supply. Messrs. Carel, of Ghent, who make these engines for Belgium, have recently introduced a high speed tandem compound type, in which the dynamos for



lighting, traction, and other electrical purposes are coupled direct to the crankshaft. These motors are strong, with a sensitive governor, and run very noiselessly and steadily, whether at full or half power, at speeds varying from 90 to 125 revolutions per minute, developing 250 H.P. to 1,200 H.P.

The Sulzer engines are always very efficiently steam jacketed, and work with a large number of expansions. They have been repeatedly tested by various independent experts and professors, and have been proved to give the lowest consumption in pounds of feed water per I.H.P. per hour of any engine now made. We propose to treat this question of economy of consumption in a second article. The engines work with either saturated, dry, or superheated steam; the latter is the most economical, as with it, condensation of steam in the cylinder of an engine is considerably diminished. The steam and exhaust valves are known as lift valves, and there are four to each cylinder, opened and closed by cams. The writer has seen a number of these engines at work, and has also several times had the opportunity of inspecting the large and well-designed engineering works of MM. Sulzer and MM. Carel. The former employ some 5,000 hands at Winterthur, and at their branch works at Ludwigshafen, in Germany. Messrs. Bryan Donkin and Co. are makers of the engine for Great Britain.

About 99 engines, some very large, and others smaller, have already been supplied by MM. Sulzer to drive dynamos for producing light, traction, and power. Of these, 54 are at work in Germany, 13 in Russia, nine in Switzerland, nine in Egypt, four in Mexico, four in Austria, four in France, and one respectively in Spain and at Johannesburg. Out of this number 32 are used for electric lighting only, 14 for electric lighting and power, 19 for electric transmission, 28 in chemical and other works for electrolysis, and six for electric traction. The power of these different engines varies from 50 to 3,000 B.H.P. The largest and most powerful plant is the installation at the modern Central Electric lighting station at Berlin, where there are five vertical compound engines, three of 1,800 B.H.P., and two of 3,000 B.H.P., all working with superheated steam. Three tandem engines of 360 B.H.P. furnish electricity for the central station at Rheinau, two tandem 450-B.H.P. at Brunswick, one tandem 250-B.H.P. at Brugg, three tandem 900-B.H.P. at Mannheim, and two triple 1,500-B.H.P. at Elberfeld; the five latter engines are worked with superheated steam. At the Frankfort electric station there are also two large tandem engines, each of 1,500 B.H.P., and three of 450 B.H.P. at the electric station at Crefeld. At Ludwigshafen, where MM. Sulzer have an important branch establishment, there are two engines of 360 B.H.P., and a compound 100 B.H.P. for electric lighting, and two tandem 360-B.H.P. for electrolysis in some dyeing works. An important installation is at Cologne, where the Central Electric station has four compound 600-B.H.P. and two triple 1,200-B.H.P. engines, while smaller engines of 250 B.H.P. provide the power for lighting electrically two important cotton mills at Leipzig and Kaiserslautern.

Coming next to other countries, there are four single cylinder Sulzer engines at a factory in Alexandria, two of 50, one of 100, and one of 200 B.H.P., and at the same factory, at Cairo, there are four small, and one compound, 400-B.H.P. engines. All these are used exclusively for electric lighting. Several installations are working in Russia, where Sulzer engines are much appreciated. One of 200 and one of 250 B.H.P. drive the dynamos to light a factory at St. Petersburg, but the bulk of the engines in Russia are

used for mill power, namely, a triple 800 B.H.P., quadruple 1,200 B.H.P., and two triples of 250 and 1,200 B.H.P. at Moscow, a tandem 200 B.H.P. at St. Petersburg, and four in the provinces. The applications of the engine to electrolysis are numerous. There are two compound 250-B.H.P., and two 500-B.H.P. used for this purpose in Mexico, four at Paris, and several in Germany and Austria. At the important Zurich Electricity Works there are two compound 300-B.H.P. engines for generating light and power, working with superheated steam.

Electric traction is a development of engineering science still in its infancy, but which is likely to be much used in the future. At Basle the electric tramways are worked by four tandem Sulzer engines, two of 120, and two of 400 B.H.P., and there are two tandem engines driving the tramways at Lodz, in Poland. The mechanical efficiency of all these engines is from 86 per cent. to 89 per cent., according to the load, or, in other words, from 11 per cent. to 14 per cent. of the power is absorbed to drive the engine itself.

MM. Carel, of Ghent, have also supplied 31 engines, several of which are used for municipal Electric Works. Three tandem engines, two of 800 H.P., and one of 350 H.P., provide power for lighting the town of Nancy, and five large compound engines, with an aggregate of 3,000 H.P., are working at the central station at Brussels, and have lately been inspected by the writer. There are two, each of 500 H.P., and one large tandem of 1,000 H.P. at Antwerp, while two tandem engines of 300 H.P. supply the town lighting at Rouen. All these are slow speed engines, none running at more than 100 revolutions per minute. MM. Carel have also supplied Sulzer engines for Russia. There are four tandem 400-H.P. engines at Tsaritsyne for electric transmission, and a compound of 250 H.P. for electric lighting, and six engines provide power in various factories. The tramways at Belgrade are worked by two tandem Sulzer engines of 400 H.P., and those of Kazan, in Russia, by three single cylinder 350-H.P. engines.

The above are the chief applications of the Sulzer engine to generate electricity. Owing chiefly to the excellence of its construction and valve gear, it has made its way, as our list shows, into almost every country. It works not only steadily and well, but with great uniformity of speed, and also, it is claimed, with the highest economy yet realised in steam engines.

CONDUIT v. TROLLEY.

Amongst all the clamour raised by the ignorant or prejudiced on behalf of conduit electric traction schemes, it is somewhat refreshing to read particulars of a trolley system actually at work within the walls of Paris—the fair city of Lutetia that has held out for a long time against the erection of a trolley wire, and has even, not so very long ago, forced on the use of accumulator cars, both those wholly dependent on the batteries throughout the entire journey, and those also (like the Hanover and Dresden cars), which are run by accumulators over certain sections of the line, deriving current from the trolley for the rest of the journey.

It is all very well for people to say that there should be no reason why the conduit (*i.e.*, the open slotted conduit), should not work perfectly well in the big cities of France or Great Britain as it presumably does in Brussels, Buda-Pesth, Berlin, and, more especially, New York; nay, even the rashly courageous Glasgow Corporation is deciding to try conduit instead of trolley. It is, we say, all very well for the outside public to argue from instances, and even for engineers to juggle with figures, but the fact—the one solid fact—remains, that the conduit costs from two to three times, at least, as much as a trolley system for the same lines; and tramways would only prove to be very remunerative under these conditions in such crowded thoroughfares as Broadway, in New York, Oxford Street, or City Road, in London, or the Boulevards of Paris. It would probably be worth spending £50,000 per mile on a conduit line down Broadway so long as the powers can be got. A city may forbid the erection of trolley wires down its principal street, but if the traffic is as enormous as it is, for instance, along Broadway, the cost of the line is (within very wide limits) immaterial. The main thing is to get the line there in the public benefit, and trust to the enormous traffic for recouping the necessarily enormous cost.

But how many thoroughfares are there like Broadway, and how many "Metropolises" has any country? Probably there will not be found more than one or two routes in each big centre like London, Paris or New York, where the consideration of traffic will justify such an outlay for what is, after all, more or less a whim and a fad. Take, however, a small system, say, of 12 miles in all. The extra capital outlay upon this for conduit as compared with trolley would be at least £150,000, and the additional revenue necessary even for dealing with this capital from the 2-per-cent.-cheese-paring-sinking-fund-municipal standpoint is at least £7,500, which is equivalent to quite 2d. per car mile on a reasonable traffic service for such a system.

How many ordinary lines or networks can stand a dead-weight of 2d. per car mile merely to satisfy a local prejudice against overhead wires? The money had better be spent on developments in other directions—in branch lines to outskirts where healthy conditions of living can be got.

The reasons for building conduit lines in New York and Berlin have been sufficiently dealt with already in these columns, and need not therefore be repeated here: it is enough to say that the same feeling and prejudice has existed in Paris against overhead trolley wires, but that the result of using this method in the smaller provincial towns, such as Havre, Marseilles, Lyons, Bordeaux, Rouen, Roubaix, Nice and Versailles, has been to convince the authorities of Paris of its innocuousness (when properly installed) along all but the principal thoroughfares.

The erection of overhead wires at Versailles brought this method as close to the Parisians' eyes as the proposed light electric railways round Hounslow and Richmond will do to Londoners; whilst the equipment, quite recently, of the Aubervilliers-Place de la Republique line just outside the walls of Paris led the way for a quite logical extension of the system within the city on the Bastille-Charenton line.

True, it must be confessed that even here some restriction has been placed upon the trolley wire, which is forbidden upon two short lengths in favour of the open slotted conduit; but five-sixths of the total length—4 miles—is equipped with overhead wires: and the probability is that the next section of tramway in Paris to be converted for electric working will operate entirely by the trolley, for not even the most critical æsthete could raise serious objections to the extremely elegant design of centre poles and other equipment used on the Bastille-Charenton line, as compared with such structures as lamp-posts and kiosks already existing along the streets.

The centre pole bracket arms are extremely short, and have not an inch of straight tube about them, but are formed of scrolls and stays, which give a very neat and elegant appearance whilst there seems no reason why they should not be as strong as the plain gallows-like erection considered suitable by most engineers in this country. The trolley wires are attached to hangers which are themselves carried on very short span wires, a foot or so long, stretched across the up-curving bracket tubes like the chord of a bow. This gives a much more elastic suspension than the old solid method of clipping the hanger direct to the bracket tube, and is now practically adopted on all new electric lines.

The short conduit sections installed on this line are, as stated, of the ordinary open centre slot form, with a concrete lined channel containing two T-shaped conductors for side contact plough. They are fed by means of a separate main cable, and as a stand-by are also connected with a large storage battery, put in specially for the conduit.

The cars have a very elegant appearance, and resemble somewhat the ordinary railroad saloon carriage in regard to their lavishness of interior decoration and big plate glass windows, instead of the usual small movable sashes. They are provided with both trolley poles and contact ploughs for the short conduit sections, the latter being thrown in or out of contact by means of a lever at the side of each car.

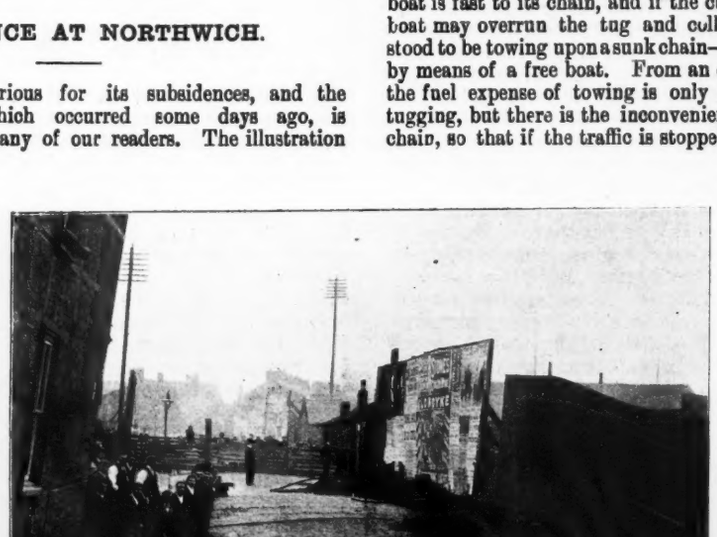
The movable points at crossovers and termini on the conduit sections are very neatly designed, and deserve

some attention from permanent way engineers; the pivoted tongue is formed practically in two parts, an upper and a lower, and the latter (except at the moment when a car is crossing over) is carried by brackets bolted to the inside of one slot rail. Under ordinary conditions, therefore, the weight of any street vehicle passing over the junction point is taken directly by the slot rail and concrete foundation. Of course, the conduit junction point is interlocked with the points of the track rails, by means of a rod running underneath the contact conductors.

Other particulars, with a number of interesting illustrations of this latest development of electric traction in Paris, are given in a recent number of *L'Industrie Electrique*, to which journal we are indebted for much of this description.

SUBSIDENCE AT NORTHWICH.

Northwich is notorious for its subsidences, and the most recent one, which occurred some days ago, is probably known to many of our readers. The illustration demonstrates in a very striking manner the difficulties which the local electrical company has to contend with.



Subsidence at Northwich.

The subsidence occurred on the 15th ult., breaking one of the cables at a junction box which happened to be in the centre of the depression. If there can be any degree of fortune in such an event, it was, perhaps, lucky that the subsidence occurred during the day; had it happened at night it would, no doubt, have caused the main fuses of the system to blow and interrupted the town supply. The extent of the disaster may be understood when it is said that the cavity is the full width of the road, some 18 yards, and is, moreover, 16 feet deep. After much difficulty the cable was recovered, but the junction box had entirely vanished.

It is evident that the company's officials possess unusual energy and skill in meeting such untoward occurrences, for the cable was reconnected and current supplied through it the following day. Such accidents would almost justify the company retaining a submarine cable engineer who had experience of grappling for cables in ocean depths.

ELECTRICAL CANAL TRACTION.

I.

The *Bulletin* of the Association of Electrical Engineers of Liege for May of the current year was entirely devoted to the question of canal traction, mechanical and electrical. While far too lengthy to produce *in extenso*, or even to abstract at any length, we hope in the following series to be able to give such a *résumé* of the salient points as will be of use and interest. The canals of England languish in the grip of the railroad interest, but the time must arrive when even a Parliament, packed with selfish railroad directors, must give attention to so vital a question. The author of the paper, which appears in the *Bulletin*, was Mr. Van der Wallen, who remarked at the outset that canal traction was to-day in a very backward state considering the great development of late of different modes of traction. Everywhere one sees animal haulage, the animal being victorious over the numerous tentative efforts to replace him by mechanical means.

All canals have been built with a view to haulage in some form, and it is to improve on this mechanically and economically that efforts should be made. On rivers and large canals the problem is different. Self-towing and towing are the only practicable means capable of being utilised. Self-towing on a chain is excellent on rapid streams of small depths having at least a slope of 0·30 m. per kilometre. The draught of water augmenting and the slope falling below 25 cm. the tow boat sees its superiority well reduced. On the descent the advantage is always with a tug, for the tow boat is fast to its chain, and if the current is rapid the towed boat may overrun the tug and collide. Towing is understood to be towing upon a sunk chain—as distinct from tugging by means of a free boat. From an economical point of view the fuel expense of towing is only about one-third that of tugging, but there is the inconvenience of being fast upon a chain, so that if the traffic is stopped the tow vessel is idle, but a tug has a much wider field and can go anywhere, and, moreover, is of less first cost. Some large companies have both paddle and screw tugs. Paddles are suitable in shallow waters, but are costly in construction and work. The Company of the Lower Seine and Oise have vessels fitted both for chain towage and tugging. Up stream they are towers, down stream they are free tugboats, and they afford a service at once quick, regular, and economical. MM. Molinos and Bovet consider this the best system of traction for canalised rivers.

Compared with the ordinary system of towage, there is less use of the chain, a stoppage of the chief causes of breakage, better utilisation of plant, and an increase of the possibilities of traffic, with reduction of expense and the power to run down stream as free tugs.

Compared with tugs, the advantages of the double system are equality at times of low water and an incontestable superiority at times of high water. For such a service to pay, the traffic should be large and the locks also large enough to take a train of barges. A train of four barges, for example, occupies four hours, and a single boat less than 30 minutes, so that a convoy loses 90 minutes at each lock if of one boat capacity. Experience has shown that the mean speed of such a convoy cannot be over 3·6 kiloms. per hour on a canal which is much used. Similarly, a horse-hauled boat attains nominally 2 kiloms. speed. To regain an hour lost at a lock a convoy would need to travel 6 750 kilometres. Thus the towage of trains of four boats cannot be carried out except at a disadvantage as regards speed, unless the pools between the locks are each 6·750 kiloms. in length.

It is thus evident that the question of economy depends very much on the distance between, and the size of, the locks. To have a towing vessel, whether on a chain or with screw propulsion and the attendant expense in the shape of fuel, attendance, and repairs, there must first be a

sufficient traffic to supply several barges at one time to be towed. The towing vessel must not tow a single barge, but a train. Now, if the locks are only large enough to pass one vessel at once—which is the case with almost all our English canals—there will be a considerable loss of time at each lock, and if locks succeed one another quickly, the journey speed will be very slow indeed. Clearly there is a good deal of thinking to be done upon each problem. On very busy canals, with pools of suitable length, it would be practicable to maintain the towing vessel always in its own particular pool. It would never pass the locks, but occupy itself in towing barges each way from lock to lock. When such a system is practicable it would save time at the locks, and would also save a considerable difficulty at the locks in the shape of the management of the tow chain.

Another solution of the question is that of self-propelled barges. Erroneous apparently in principle, because of the idle time of the motive power at times of loading, yet it is capable of successful application for carrying goods necessitating high speed.

The use of gas and oil engines offers the chance of reducing some of the foregoing objections. One instance alone is cited—that of the French company, Seine Maritime, which conducts a rapid service between the English Channel, Rouen, and Paris, by means of flats driven by gas motors. The gas is carried in steel tubes at a pressure of about 100 k. per cm^2; these tubes measure 250 mm. diameter, and are 5 m. long and 8 mm. thick to contain 22 m^3 of gas. They weigh 325 kilos. These tubes, to the number of 80, are connected in a battery by flexible joints. The motor is vertical, with two cylinders of 40 H.P. total of the "Simplex" type driving a screw on the McGlasson principle, variable and reversible, which permits any speed from *nil* to maximum without change of speed of the engine. Two men manage the boat, a driver and a pilot. Such a boat will measure 300 tons, and will be 30 m. long, 5·50 m. beam, and 2·25 m. deep. Trials between Havre and Tancarville show that one minute is enough to set the motor going, and at 180 to 250 revolutions, the flat, carrying 145 tons, travels 5½ to 6 knots.

This system appears to be the counterpart of gas tramway traction. It is necessary to have either gas compressing stations or that each vessel should be able to compress its own gas. This would be somewhat impracticable and costly, and gas haulage would seem only to be applicable under special conditions as to the supply of gas at the convenience of a suitable station for its compression, or the presence of a compressed gas main with connections for the boats at several points *en route*. Strong gas alone can be carried in reasonably small bulk, so that producer gas would be shut out, otherwise gas haulage seems very suitable for canal barge towing. It has one great advantage not possessed by the tramway gas traction that, the resistance being practically constant, the gas motor may be exactly suited to its one duty—that of haulage at the level. On tramway work the gas engine must be very much larger than its mean power, for it must provide both for rapid acceleration and for the maximum grade. Electricity can do both, because in electrical work the energy comes from outside. In a gas engine the energy is generated by the engine, which must be large enough for its highest duty, and, unlike an electric motor, cannot be overloaded. An electric motor will utilise a heavy current for a few minutes and is at a great advantage in this compared with gas. On canal work, however, these particular advantages lose their value, and in canal haulage we should expect gas to give good results on such systems as were suited for its adoption.

The following are stated as essentials of mechanical canal traction:—A power of 3 H.P. to 4 H.P. effective, capable of being augmented, even at a reduced speed, at the passage of a lock.

The systems at present capable of filling these essentials may be placed under three heads:—

(*a*) An endless cable kept in constant motion to which barges may be attached.

(*b*) Machines in place of horses, running the length of the canal.

(*c*) Temporary motors placed on board the boats and easily moved so as to serve any boat, and so be utilised without interruption.

Under the first head comes cable haulage, first proposed in 1862, and now only of historical interest.

The moving cable does not seem to have been a success. One difficulty was the obliquity of the pull on the cables, and the difficulty of passing the haulage rope past the carrier pulleys. It was difficult to attach tow ropes to the moving cable, and there was the sudden pull on the rope as soon as attached, and no time was allowed to the boatmen to get aboard again. To enable the tow rope to quit the pulley groove, the flanges of the latter were notched, and when the notch came round it admitted the tow rope and so led it off and out of the groove, the straight running main rope not catching in the notch. We need not further follow the description of this rope system, which is fully described and illustrated in respect of grips and pulleys. The system is not one likely to come into use in face of the possibilities of electric traction. Unlike tramway cable traction, the moving cable in barge haulage cannot receive back any power from boats as does a tramway cable from cars running down hill. Then it is obvious that there must be an enormous loss of power by friction at the numerous pulleys, especially at curves where the rope has a heavy lateral pressure on its carriers.

Under the second head, that of travelling machines, it is remarked that at the outset no success accompanied the system. A trial was made with a locomotive running on the bank of the canal of Neuff-Fosse, between Fontinettes and Douai, on a length of 77 kilometres with one lock only. The line was ballasted on a width of 2 metres and a depth of 0·3 m. The rails weighed 15 k. per metre, and were laid on cross ties of wood spaced 1 metre apart. The locomotives had four coupled wheels and weighed 14 tonnes in working order, which seems an excessive weight, but each train consisted of two or three boats, and the speed was 1,500 kilometres per hour. The chief cause of the abandonment was the cost of the railway, and the heavy engines required. In 1892, however, electrical traction was tried on the patent of M. Galliot, upon the canal of Bourgogne. The Society Denèfle & Cie., who worked the patent, constructed a kind of electrical tricycle. The overhead trolley system was employed. The cable was fixed behind, between the motor wheels. The motor is bipolar of 6 kw.

The shaft gives motion by a bronze worm to a wheel on the axle of the driving wheels, which are of iron wrapped in aloes fibre for elasticity and grip. The vehicle carries a light cab or shelter in which the driver controls the machine with the necessary levers and foot brake. The whole machine only weighs 2 tons.

A third system is that of Lamb, and consists of electrical motors running on cables and hauling boats as in the previous system. A strong cable is carried on posts on the bank. A carriage runs on this cable carrying a motor which drives a wheel by means of a worm. Round this wheel is once wound a second or traction cable. The haulage rope is attached to the carriage. The two cables are so isolated as to serve for conductors. The worm runs in an oil bath with very little friction. The motor can be driven from deck by means of suitable wires carried on the haulage cable, or there may be a driver seated on a suspended seat from the motor itself.

M. Busser proposed in 1893, at the Chicago Congress, to place a motor in a float attached to the rudder of a barge, and to drive a small screw propeller therewith by means of a chain, and a similar proposal was made by M. Gaillot at the Congress of the Hague, a screw propeller being driven by a motor through a vertical shaft in the rudder post.

TELEPHONE PURCHASE.

In a leading article the *Economist* of last week discusses the scheme suggested by the Council of Associated Stock Exchanges for the purchase of the National Telephone Company by the State. The suggestion is that the property should be bought by the Government on the basis of the average prices of the company's securities for the past three years, on which basis the purchase price would amount to £6,850,553.

In a letter to the *Times*, Mr. Rae, of Liverpool, the President of the Council of Associated Stock Exchanges,

suggests that the purchase may be made either by unemployed funds in the hands of the Post Office, or by the issue of terminable annuities, or of £6,525,000 2½ per cent. consols at £105 per cent. The interest charge upon the purchase Mr. Rae takes as £165,125 per annum (an error apparently for £163,125), the net receipts for an average of three years are £428,925 leaving "a balance of £265,800."

The balance of £265,800 placed to a sinking fund at 2½ per cent. would, Mr. Rae calculates, amount to £4,000,000, or including the average progressive increase, to £7,000,000, and he thinks "the Post Office would be fortunate in securing the extinction of the telephone company's license on such terms."

In dealing with the scheme, the *Economist* says that "any proposal to get rid, on reasonable terms, of the company and its grossly misused and oppressively exercised monopoly cannot fail to meet with favourable consideration." The scheme at first sight is attractive, but ceases to be so on closer examination. The proposal is capable of justification only on the assumption that the company ought to be given "a rich pecuniary reward" for its past misdeeds. "The company has charged extravagant prices for an inefficient service," thus earning "big profits," and to capitalise the purchase price on the basis of such profits would be to make all its past shortcomings redound to its present gain." Moreover, the profits were earned and the market value of the company's securities appraised "on a false understanding of its position." It claimed to be protected against competition, and "documents which would have shown that claim to be without a fragment of foundation were kept from the knowledge of successive Postmasters-General." The *Economist* considers these points to have been proved by the report of the recent Committee, who advised that there was an entire absence of any limitation upon the unrestricted right of the fullest competition. The *Economist* shows that the recent investigation had reduced the value of the company's securities on November 30th to £5,809,038, and remarks that the proposal referred to would thus allow for a purchase price of more than a million than they are now worth.

For our own part we cannot consider the proposal altogether sound, any more than we can regard the *Economist's* conclusions as altogether fair. It is obviously unreasonable to take the market valuation at a moment of depreciation as representing the value of a concern which has both a past and a future. The Stock Exchange proposal leaves out the future, and sets rather a bad example. The market prices of securities generally comes to be measured by the yield. If dividends are declared up to the hilt while the capital account is unduly swollen, the market price may be retained at a high figure for a period long enough to give a high average, and to enable the holders to "unload" at an inflated value. It is rather as a matter of setting an example than in considering its merits in the present case that we make these remarks. Expert investigation of books and plant can alone determine the basis of present values, and probably no one outside the Post Office and the company is capable of judging to what extent the valuation may be affected by the possibilities of the future. The *Economist* adopts the insinuation of the Committee, or some of its members, in suggesting that documents were, "by some means or other," kept back from successive Postmasters-General, and thus reflects most unjustly, as we strongly believe, on some officials. In all official documents the right of the Post Office to compete or permit competition was fully reserved. It is to be regretted that in preparing for a change of policy the Parliamentary head of the department should have considered it necessary to pursue a line of examination which inferentially reflects unjustly on zealous and capable officials. Whilst rights were reserved it was not the policy of the Post Office to exercise them. The Parliamentary Committee has recommended that the reserved rights should be exercised, and the recommendation has, unquestionably, an important bearing on any estimate of the value of the existing business. It is not necessary for us to repeat the disadvantages of competition, and therefore the desirability of Government control, which we have consistently maintained. It will certainly be more advantageous for the Government to purchase at a fair price, and for the company to sell at a fair price than to involve themselves in a competitive struggle, but what that fair price may be can probably only be determined by the two contracting parties. It is certain that the public will not readily acquiesce in an excessive figure, and it is equally certain that it would be unwise to assume from expressions of prejudiced or ill-informed declamation that the public will permit any act of spoliation.

COMBINED DESTRUCTOR AND ELECTRIC LIGHT PLANTS.

By ERNEST KILBURN SCOTT.

Outside the question of figures and accounts there are several points in connection with "combined destructor and electric light plants" which might be ventilated with advantage.

Situation and Output of Station.

For the sake of argument, let us take the maximum output of all the Shoreditch refuse at 400 kilowatts (as a matter of fact this is only obtained with the help of refuse contributed by the surrounding parish and exhausting work on the part of the men). We have, then, a complete electric light station capable of holding plant equal to, say, 6,000 kilowatts, built in conjunction with a destructor which, when it is doing its utmost, can only supply steam for one-fifteenth part of this output. And what is 400 kilowatts? The Electric Construction Company and Messrs. Siemens are each building a dynamo for the Manchester Corporation of over four times that output (1,700 kw.), whilst the usual inquiries at this present moment from the various towns where electrical works are established are for units of 500 kilowatts and upwards.

Name.	Population.	Area.	Rateable value.	Total capacity of generating machinery.	Maximum load observed.
		Acres.	£	Kilowatts.	Kilowatts.
Shoreditch ...	124,000	648	693,732	705	408
Hampstead ...	75,499	2,248	805,443	1,710	632
Westminster ...	133,234	1,426	...	4,533	3,6[illegible]0
Brighton ...	121,400	2,620	772,996	2 090	1,763

The accompanying table gives particulars of the capacity of generating plant for areas having a population somewhere near that of Shoreditch, and it is instructive as showing what proportion the destructor output is likely to bear to the whole if the electrical side is allowed to develop properly.

At Cheltenham the electric light station was built miles away from anywhere so as to be supplied with steam from the destructor, and in order to use the same chimney. What is the result? The connecting steam pipe used for about a week, and the chimney found to be far too small. The electric light station, therefore, does not benefit in any one way, whilst there are the disadvantages of running electrical machinery in a dirty situation, and the heavy extra expenditure on feeders. Take Ealing, or St. Pancras (King's Road), and here again we find that there are no advantages whatever in having the electric light and destructor plants together.

Moral.—If it is decided to use destructor steam for electric lighting purposes instead of utilising the heat in the more legitimate object of sludge cremation, then, for goodness sake, let the combination be looked upon in its proper light of a sub-station only, or a small plant with which to make a start. *The situation for the main electric light station is surely worth considering on its own merits alone.*

Management and Staff.

It is sometimes stated in engineers' reports that one advantage of having the two plants together is that the same staff can be employed. Surely this borders on an absurdity! Just fancy a navvy from the destructor being called in to take a turn as switchboard attendant or *vice versâ*, to say nothing of the muddling of accounts. As with gas and electric light it would appear to be highly important that the destructor and electric light works should be controlled

by *two* separate committees and managers. It is obvious that the combination will give the best showing when the electric light load is such that there is enough destructor steam to supply it. In other words, there is a great temptation to keep down the electric light plant to the level of the destructor output. At Shorditch the cry all along has been, "Look at us, we are running our electric light station entirely with refuse," but they conveniently forget to say that the electrical output is only 300 or 400 kilowatts, and that in order to get this, good quality rubbish has to be brought in from outside areas.

Design of Buildings.

At all destructor stations the writer has seen, there have been unmistakable evidences of the presence of large quantities of fine gritty dust.

In the event of a destructor and electric light plant being combined, it appears to the writer that they should, at any rate, so far as doors and windows, &c., are concerned, be isolated as far as possible. How troublesome the dust can be, is shown by the careful swathing of all electrical plant in canvas covers. Dumping the refuse twice, of course, adds to the nuisance, and for this reason an inclined road and single dump is undoubtedly best even at the expense of more land being occupied.

Thermal Storage System.

It is said that this system is to be given a further trial at the South London electric light station, and Messrs. Siemens may be able to make something out of their plant, but it is extremely doubtful if what the writer has been told is anywhere near the mark. One point might be mentioned. The storage cylinder (33 feet by 8 feet diameter) at Shoreditch is perched up aloft on a structural framing, obviously a bad position considering the vibration and unequal expansion.

Fortunately only one out of the four or five cylinders has been delivered, and this will no doubt be brought into use as an ordinary water tank, but the 10-inch steam piping, the connections, and other expenses attached to the business is so much dead loss to the ratepayers.

Conclusion.

Finally before deciding whether to utilise destructor heat for electric lighting purposes, the following points appear to be worth consideration :—

(*a*) Destructor cells cover a considerable area compared with an ordinary battery of boilers, and consequently the steam piping with its attendant expenses of joints, valves, bends, traps, covering, &c., will be a very much heavier item.

(*b*) Either very large storage room for rubbish must be provided where the refuse can be gradually warmed up (and this is unpleasant) or else the boiler plant must be practically as large as if the destructor were not used at all. This is necessary, because at holiday times and in frosty weather &c., little or no refuse would be delivered at the station, whilst on wet days the steam raising value is low. At some time or other coal must be used to assist the destructor, and the boilers are consequently more expensive as they have to be specially fitted for both destructor gases and coal firing. Moreover, where a number of small boilers are employed, as at Shoreditch, instead of one or two of usual size, the arrangement is such (cell, boiler, cell, boiler, and so on, there being 12 cells and 6 boilers) that the coal pile is all over the place as it were. Stoking is therefore more expensive than with an ordinary water-tube boiler battery having all the fire doors close together.

(*c*) Under the best conditions of refuse destruction the steam pressure must vary considerably, and it is practically essential for the engines to be fitted with automatic cut-off gear, and even when so fitted an attendant must stand by the stop valve. At Shoreditch the steam pressure may be anything between 200 and 120 lbs. within a few minutes, so that hand regulation and stand-by engines are necessary. This drop in steam pressure may be due to a quantity of soppy stuff which may be shot in or the cells may have grates that require clinkering every 30 minutes or so, and, having no damper, the opening of the fire door admits a quantity of cold air into the flues.

THE APPLICATION OF SUPERHEATED STEAM.

In a paper on this subject, read December 8th to the Northern Society of Engineers, Mr. Schou confined his remarks practically to the description of the plant and methods of Mr. Schmidt, of Cassel. He claims that in one case of a Schmidt engine of 750 H.P. compound type driving a rolling mill, the steam consumption is only 8¾ lbs. per I.H.P.-hour, and he himself claims to have tested a 70 H.P. engine in an Irish ice factory to 10·2 lbs. per I.H.P.-hour. In Schmidt's tandem engine the two pistons are in one piece, the front of the cylinder being a receiver and the annular space between the two pistons the L.P. cylinder. Thus there is no rod in the H.P. end. The receiver steam can enter the H.P. piston to keep this "cool," while the L.P. cylinder is kept hot by the receiver steam. Schmidt is credited with a new idea, which, however, is only partially new. He supplies steam highly superheated, and he also supplies straight boiler steam at the same time to the same cylinder. He varies the proportions according to the cut-off ratio, earlier cut-off demanding a larger proportion of superheat.

The idea of mixing steam is old enough; it is, so far as we know, due to the Hon. John Wethered—See "The Steam Engine and Other Prime Movers," by W. J. M. Rankine—and called by him "combined steam." Schmidt admits superheated steam alone at short cut-offs, but as the degree of expansion becomes less the governor admits saturated steam from the boiler so adjusting the total superheat to the requirements. Schmidt also uses the superheated steam as a reheating coil in the intermediate receiver. This idea, of course, is not new. Schmidt's superheater is made from lap-welded tubes of 1 inch to 2 inches diameter, according to the size of apparatus, arranged in coils, and the pipes are in long lengths with no joints in the heat. They are heated either in the flues or by direct fires. The steam travels in the first place in a contrary direction to the gases until it is dry. It then travels in the same direction for superheating so that it may not become too hot, the most highly heated pipes containing the steam simply dry and not yet superheated. Schmidt has also brought out an economiser or flue feed heater which, we believe, is novel. He uses distilled water in this apparatus, so that it never incrusts. This is kept in constant circulation over and over again, and its heat is abstracted in the feed heater, the "distilled" coils giving up their heat to the water in this. The feed is thus heated indirectly, but, doubtless, efficiently, and as the distilled water re-enters the fire coils at a fair temperature these do not become corroded externally as is the case with all cold fed economisers, and there is no adherence of soot which can be blown off by a steam brush.

The pleasant City of Manchester is promised shortly a 1,000-H.P. Raworth engine, using steam from boilers heated by Mond's producer gas and passed through a Schmidt superheater. There will be two boilers to supply 10,000 lbs. of steam per hour, but the paper does not inform us of what type these boilers are to be, but when we hear of producer gas to heat steam boilers we are inclined to expect very moderate evaporation. Producer gas has not much evaporative efficiency in most boilers. Why not use gas engines in place of the circumlocutionary course of boilers, superheaters, and engines. Mr. Schou's paper, despite being simply an advertisement for one particular superheater, is interesting, and we fully agree with him as to the benefits of superheat, though we may have broader views as to other inventions, and are possibly less hopeful as to the very high degrees of superheat or the benefits obtainable from the top ranges. There is so much possible with the first 100 or 200 of superheat that the margin beyond is already considerably narrowed.

Superheating is like expansion—it shows a big economy at once, and the higher ranges bring in so much of counteracting effects, that their nominal benefits are difficult to fix. The higher limits of all branches in mechanical engineering are very much on a par with the problems of rope driving. For a time it appeared that a rope increased in driving capacity with its velocity, but centrifugal force soon demonstrated a low limit of 80 feet per second, and very little improvement beyond 60 feet. In fact, higher velocities than 60 feet are really due to the desire of securing fly-wheel effects.

SHOREDITCH ELECTRIC LIGHTING ACCOUNTS.

The Services of Chartered Accountants Suggested.

Another long discussion took place at Tuesday's meeting of the Vestry of Shoreditch consequent upon the presentation by the Finance Committee of a report submitted by Dr. Mansfield Robinson, the vestry clerk, concerning a statement made that he had been requested to sign the electricity accounts for the Board of Trade. The vestry clerk stated that he was not aware of any such order, and that he had delayed affixing his signature to the accounts in view of the expected discussion of the figures in the annual report, and that at present he felt unable to sign them, for the following reasons:—

1. The Board of Trade net revenue account does not harmonise with the Vestry's net revenue account for the same period, printed together in the last annual report, pages 363 and 352 (and annexed hereto), the balance of excess of income over expenditure in the account at page 363 being £781 1s, whilst in the account at page 352 it is £2,063 0s. 4d. (which is carried forward to the appropriation

account at page 355 as a balance of £807 12s. 2d.) This appears to arise from treating the entry from "deficit account," at page 352 of £1,255 8s. 2d. (being the advance by the Vestry out of rates to refund the deficit on the years ending March 25th, 1896 and 1897) as income earned by the undertaking from March, 1897, to March, 1898, when no charge for the corresponding expenditure is made on the other side, whereas this is done in effect in the Board of Trade account, at page 363, by debiting a balance from the last account of £1,281 19s. 4d. I am unable to follow how the above advance from the Vestry out of rates to meet deficiencies in the years ending March, 1896 and 1897, can be called income for the year ending March, 1898, although of course it is properly entered under the heading of receipts during the latter period.

2. The chief electrical engineer declined to take responsibility for the Board of Trade accounts before the Lighting Committee, on the ground that some of the items are classed under the wrong heading, *e.g.*, there is no expenditure under the headings of public lamps, (*a*) to attending and repairs, and (*b*) to renewal of lamps, whereas it appears from his books that the first item should be £154 10s. 5d., and the second £83 14s. 1d., and, again, that the items relating to wiring and fitting work are inserted in the accounts, whereas the printed Board of Trade form makes no provision for them.

3. In view of the statements made at the last Vestry meeting, that the electric lighting accounts made up for the year ending June, 1898, were "cooked," on the ground (as I understand) that no charge for steam raised from burning refuse, or for payment of interest on and redemption of bankers' overdraft was made, it is evident that the same allegation (if correct) is applicable to the Board of Trade accounts up to March, 1898, as there appears to be no charge made in them in respect of those items.

As a result of this report, the Finance Committee resolved that "To balance from last account, £1,281 19s. 4d." (as printed in the annual report), should be struck out of the Board Trade return; and "By deficiency of income, £1,255 8s. 2d." (as printed in the annual report), be also struck out, leaving the balance to be carried forward as £807 12s. 2d., and that the words "present available surplus" be also struck out. The Vestry agreed to this course, and to the sale of amended copies of the accounts.

With regard to the accounts of the electric light and refuse destructor undertaking, the Finance Committee recommended that, in view of the statements that the electricity and dust destructor accounts had been cooked, a firm of chartered accountants be instructed to audit and report on the accounts for the year ending June, 1898, as presented to the Vestry. After a long discussion, an amendment was adopted referring this recommendation back to the Committee for further consideration, and report.

CORRESPONDENCE.

Brighton Breakdown.

I am sure that all interested in this subject will feel obliged to Mr. Tapper for the information he has been able to give, and that, under the circumstances, no one will expect his estimates of time to be anything but rough. But I fail to understand his assertion that a study of the characteristic curve of a self-excited shunt dynamo will show that, assuming the short circuit increased the current from each of the remaining generators up to their limiting values before the cut-out of the faulty machine dropped, they would fail to take up the load again after the short had been removed.

He has told us that the normal speed was regained. His statement is certainly not correct if applied to a single machine, for a properly designed shunt dynamo, if run up to speed with its terminals short-circuited (and, therefore, giving no volts) will, if the resistance between terminals be suddenly increased to its normal full load value, immediately take on its full output more or less rapidly.

The same is true if the terminals are not absolutely short-circuited, so that the dynamo is initially giving current at low volts, being on the unstable lower part of the characteristic curve.

Thus, it would seem that, if a single dynamo giving, say, 500 amperes, 100 volts, at 500 revolutions were short-circuited, and then the short circuit removed, leaving $\frac{1}{5}$th ohm between terminals, and the speed brought again to 500 revolutions, the dynamo would take on its original load of 500 amperes, 100 volts, as it ought to do according to the usual theory of its action as represented by the characteristic curve.

In the Brighton instance, however, it is clear that the dynamos did not behave in this way, and in my opinion no suggestion has yet been offered which satisfactorily explains why they did not do so.

The aggregrate nominal output of the five remaining dynamos and two balancers was apparently equal to the total load on the station just before the short circuit occurred, so that it cannot be said that the load was too excessive for these dynamos to take up again as soon as the short went off.

I do not think that the explanation can be found in the fact that instead of one machine, there were here, after the short went off, five in parallel (excluding the balancers) with possibly characteristic curves slightly differing in shape. It seems not improbable that the explanation of this and other curious and exceptional cases (including demagnetisation and reversal of residual field) may be connected with the excessively heavy *momentary* armature current which may flow during short circuit.

This momentary current can, I think, considerably exceed the "limiting" current of the characteristic curve, for this curve represents matters correctly only when the magnetism is in a steady state. But when a sudden short comes on owing to the well known sluggish action of large electro-magnets, the magnetic flux will not instantaneously respond to the falling of pressure across the field terminals and to the increasing demagnetising action of the armature. Consequently a perhaps unexpectedly heavy momentary current may be generated, the requisite energy being supplied from the kinetic energy of the machinery and accompanied by rapid loss of speed.

In this way it seems possible that the strengthened demagnetising effect of the armature winding may overpower the weakened magnetising effect of the field winding, so that there may actually be a *momentary* reversing action, and this may possibly bring about some peculiar magnetic effect which has hitherto not been noticed. No reversing action, even momentary, exceeding the coercive force of the magnetic circuit, can take place on short circuit, dead or otherwise, if it is assumed that the amperes and volts vary according to the characteristic curve in changing from their initial to their final values.

I put this forward as a suggestion, but I must admit that I do not at present see that it indicates any quite satisfactory explanation in the Brighton case.

H. C. L.

"A Few Questions about Cyclic Electrolysis."

My attention has been called to the letter headed as above.

The correspondent asks why the process is called "Cowper-Cowles Cyclic Electrolytic Process." In the first place it is not called "Cowper-Cowles Cyclic Electrolytic Process," but "Cowper-Coles Cyclic Electrolytic Process." It is called electrolytic because both the lead, zinc, and silver are deposited electrolytically, and cyclic because the process forms a complete cycle when in operation.

If the reader will refer to the previous article which appeared in the issue of the ELECTRICAL REVIEW, dated August 19th, 1898, page 265, it will give him the information he seeks as regards the leaching.

The use of revolving cathodes is not confined to the Cowper-Coles process, or to the Tommasi process. It is also used by Hoepfner, although Cowper-Coles was one of the first, if not the first, to experiment with and demonstrate the advantages of a revolving cathode. The anodes in the Cowper-Coles process are made of lead.

Writer of the Article.

Steam Turbines and Unipolar Dynamos.

We notice a paragraph in your issue of last week *re* steam turbines and unipolar dynamos.

We would wish to say that the first and principal worker to develop this class of dynamo has been Prof. Forbes, and he has from time to time taken out several patents on the subject. In 1886, not being aware of Prof. Forbes's work, we constructed a unipolar dynamo driven from a steam turbine, which, at 24,000 revolutions per minute, gave 1,000 amperes at 3 volts, and we then patented the arrangement. In 1892 we supplied a unipolar dynamo constructed on Prof. Forbes's lines, but with considerable modifications, for the Elmore Company, which has worked successfully, and which, we believe, was the first unipolar dynamo put into

commercial use. Its output is 6,000 amperes at 1¼ volt, at 1,000 revolutions per minute.

We have pleasure in sending you a copy of our general catalogue, which shows on page 22 a combination plant of turbine and unipolar dynamo for 150 kw. output at 5,000 revolutions per minute. This plant was first entered in our catalogue in 1896.

C. A. Parsons & Co.

LEGAL.

Savory v. Edward Lloyd, Limited.

Mr. Justice Day and a special jury had before them on Wednesday, in the Queen's Bench Division, the case of Savory *v.* Edward Lloyd, Limited, which was an action brought by Sir Joseph Savory, ex-Lord Mayor of London and an Alderman of the City, to recover damages for an alleged libel published by the defendants in their paper called *London*. The defendants pleaded justification. Sir Edward Clarke and Mr. J. E. Bankes were counsel for the plaintiff, while Mr. Carson, Mr. Foote, and Mr. Dunlop-Hill represented the defendants.

Sir Edward Clarke, in opening the case, said that the plaintiff asked the jury to give him redress for a most grievous and serious libel. Messrs. Lloyd said that the words complained of were not defamatory, which was their justification for the libel, but he (counsel) thought the article was most defamatory to the plaintiff. Although connected with the City for many years, Sir Joseph Savory never had anything to do with the Commissioners of Sewers, although one of the charges made against him was that he had been guilty of discreditable conduct for his own personal advantage in exercising his influence with those Commissioners in regard to the electric lighting of the City of London. The libel was published in *London* on June 30th, 1898. There were two articles, one headed "How the City Sold Its Municipal Birthright," with sub-headings: "An Electric Lighting Transaction which Enriched Members of the Corporation and Created a Monopoly," "The Lord Mayor, Sir Joseph Savory, Concerned." The article proceeded to deal with the "scheme" by which a company was promoted in order to form a still larger company to undertake the electric lighting of the City under contracts given out by the Commissioners of Sewers. In this pioneer company the defendants' journal alleged the plaintiff to be interested, and it stated that he used his influence to promote it. As a matter of fact, the prospectus of the City of London Pioneer Electric Lighting Company, Limited, appeared with the name of the Lord Mayor, Sir Joseph Savory, as chairman. The company was formed with a capital of £100,000, in 2,000 shares of £50 each. The article said that "There was a regular cycle of Hooleyism. First the Streets Committee of the Commission of Sewers granted a concession to the Brush Company and Messrs. Laing, Wharton & Down; the Exploration Company helped the Electrical and General Investment Company, Limited, which promoted the City of London Pioneer Electric Lighting Company, Limited, which in turn promoted the present City of London Electric Lighting Company." A second article in the same journal was headed "Tammany in the City." It went on to say that the exposure they were making "explains why in the centre, where electricity could be supplied for less than in any other place in London or in the country, the charges are the highest." It further set out that instead of inviting competitors with the object of providing cheap electric light a scheme was being hatched to create a monopoly; that the Lord Mayor for the time being, Sir Joseph Savory, was chairman of the promoting company; that he was also a member of the Streets Committee, who executed the electric lighting contract for the Commission of Sewers; that several other members were also shareholders in the company; that the Lord Mayor, Sir Joseph Savory, was interested in the company which financed the promoting company and was started for the purpose of making money out of the interest which the Commissioners of Sewers created and out of the contracts which it had granted presumably in the public interest.

The plaintiff was examined and cross-examined at considerable length, and Major-General Webber, who was formerly consulting engineer to the Brush Company, and frequently consulted with the Commissioners of Sewers, also gave evidence. The hearing was adjourned.

Sun Fire and Life Insurance Company *v.* Dublin Corporation.

In the Dublin Southern Police Court, before Mr. Swifte, on 1st inst., plaintiffs sued the defendant Corporation for having made default in supplying electric light to their premises on several specified dates. It was claimed that under its Electric Lighting Order the Corporation rendered itself liable to a penalty not exceeding £2 for any such default. For the defendants, Mr. O'Shaughnessy said that the case was not one of two or three 40s. penalties, but it meant tremendous liability, for it was sent out as a pioneer case. A cable was laid down which was defective, with the result that the electric service broke down. The cable laid down at the time was the best then known, and it was believed that it would last for 25 years. Electric service was yet only in its infancy, and this breakdown could not be foreseen. The Corporation were now engaged putting down a new cable, at a cost of £100,000. The default was admitted, but they denied wilful or negligent default, and he would prove that the breakdown was unavoidable, and could not have been foreseen.

Mr. Ruddle, principal electrical engineer to the Corporation, deposed that he had supervised the laying down of the original cable under the consulting engineer in 1891. That cable—the rubber cable—was then known as the best. It gave every satisfaction for four years. By some unaccountable action they had discovered that the rubber was lost, with the result that energy was lost, and sometimes the supply was stopped. They had to rip up the streets to discover the cause. The Corporation, in July, began laying down a new cable, which was guaranteed to last for 10 years. The men were still at work in the laying of the cable, which was being put down as rapidly as was consistent with safety. In November there was a breakdown in the rubber of the cable, which it was impossible to guard against. There was no valid explanation yet given of this. The Board of Trade regulations obliged them to test the cables once a week, but they tested them twice daily. On the 21st, when tested, the cable in this street was all right, but in the evening the test showed that it broke down. The transformer of these premises was spoiled by rain getting into the chamber in which it was placed. The transformer could not be repaired in wet weather without danger to the life of the operator, for wherever there was damp the current leaks. The transformer could be repaired when the current was cut off. They should not repair it until the cable would be first set right.

Mr. Shiel (for the plaintiffs) said that the want of energy which left these premises in darkness was due to the breakdown of the defendants' plant, which they should have guarded against.

Mr. O'Shaughnessy contended that the Corporation were not liable when every precaution had been taken that was possible.

Mr. Swifte said the result of the engineer's evidence was that this was an unavoidable accident. Electricity was yet more or less in a tentative position, and at the time the cable was laid down the Corporation took every possible precaution to get the best material they could. It might be a fair case to investigate, but he would dismiss the summons, giving, however, no costs.

Stegmann *v.* Williams.

In the Queen's Bench Division of the High Court of Justice on Wednesday, before Mr. Justice Grantham, sitting without a jury, this case was down for hearing. Mr. Colam, who appeared for the plaintiff, said the claim was for £80 odd for electrical appliances supplied to the defendant. He called Mr. Geo. Stegmann, who said he carried on business as an electrical appliances engineer at St. John's Hill, Wandsworth. In June last he received orders from the defendant to supply electric light fittings and electric bells to 110, Cannon Street. He had done the work, and had also supplied an electric transparent sign to the Savoy Palace Hotel, Strand, at a cost of £58 10s. The charges were reasonable, and he had sent in his account from time to time, but was still unpaid. Mr. Colam said there was no appearance for defendant, and he asked for judgment.

Judgment for the plaintiff for the amount claimed, £80 5s., and costs.

BUSINESS NOTICES, &c.

The Alleged Perjury Case.—At Bow Street on Tuesday John Limbrey Higgs, solicitor, of Delahay Street, Westminster, was committed for trial on the charge of having committed wilful and corrupt perjury under circumstances already stated in the Review. Bail was fixed at two sureties in £100 each.

Alwyn and Craven v. G. Straus & Co., Limited.—At the City of London Court last week before Mr. Registrar Wild, plaintiffs, electrical engineers, of Cow Cross Street, E.C., sued defendants to recover the price of a number of high voltage electric lamps supplied by them but which were found to give a bad light. The plaintiffs used the lamps for lighting Parr's Bank, High Street, Kensington, and they had to be taken out and others substituted. Defendants stated that the reason for refusing to exchange the lamps was that there had been a delay of five months before a complaint was lodged. The learned Registrar said it seemed from the evidence that the lamps would not give a proper light, and also he found that complaint was made in a reasonable time. Judgment for plaintiffs for the amount claimed (£1 3s. 3d.) and costs, the lamps to be returned to the defendants.

Asylum Lighting.—Mr. F. Shalders, of Southampton, has secured the contract for light and power plant, also wiring, at the Hants County Asylum, Knowle, near Fareham, as recently advertised.

Books Received.—"Michael Faraday: His Life and Work." By S. P. Thompson, D.Sc., F.R.S. Cassell & Co., London. Century Science Series.

"The Life Story of the late Sir Charles Tilston Bright," by E. Brailsford Bright and Charles Bright. 2 vols. Published by Archibald Constable & Co., Whitehall Gardens. £3 3s.

"Tutorial Algebra." Part II.—Advanced Course. By Wm. Briggs and G. H. Bryan. London: W. B. Clive, University Correspondence College Press. 6s. 6d.

Electrical Wares Exported.

Week Ending Dec. 6th, 1897.	£	s.
Alexandria. Teleg. mat.	85	0
Amsterdam	126	0
Bombay	111	0
„ Teleph. mat.	80	0
Buenos Ayres	11	0
Calcutta	102	0
Cape Town	472	0
Chinde	1,060	0
Colombo...	60	0
Copenhagen	22	0
Delagoa Bay	163	0
Durban	1,128	0
Fremantle	28	0
Gibraltar. Elec. cable	1,800	0
Gothenburg	452	0
Halifax Electric cable	4,500	0
Hamburg	10	0
Hong Kong	40	0
La Plata. Teleg. mat.	143	0
Launceston	595	0
Lyttleton	45	0
Madras	50	0
Melbourne	65	0
Monte Video	22	0
North Sea. Teleg. cable	1,661	0
Port Elizabeth	32	0
„ Said	48	0
Rio Janeiro	24	0
Rosario	17	0
Santa Cruz	10	0
Shanghai	96	0
„ Teleg. cable...	140	0
Singapore. Teleph. mat.	114	0
Stockholm. Teleg. wire	441	0
Sydney	1,885	0
Wellington	20	0
Yokohama. Teleg. mat.	52	0
Total	£15,708	0

Week Ending Dec. 6th, 1898.	£	s.
Adelaide	55	0
Barcelona	115	0
Bombay	110	0
„ Teleph. mat.	42	0
Boulogne	109	0
Buenos Ayres	1,427	0
Calcutta	1,775	0
Cape Town	309	0
Christiana	54	0
Cienfuegos. Teleg. cable	397	0
Durban	276	0
„ Teleg. mat....	72	0
East London	254	0
Ghent	33	0
Gibral'ar	24	0
„ Teleg. mat. ...	750	0
Hobart	20	0
North Atlantic { Teleg. cable	1 000	0
Port Elizabeth	330	0
Shanghai	285	0
Singapore. Sub. teleg. c'ble	192	0
Sydney	1,130	0
„ Teleg. mat. ...	56	0
Trinidad	36	0
Wellington	179	0
„ Teleg. mat.	1,257	0
Total	£19,317	0

Foreign Goods Transhipped.

Wellington. Teleph. mat.	2,574	0	Brisbane. Telephone...	44	0
			Rotterdam	35	0
Total	£2,574	0	Total	£79	0

Another Large Power Scheme.—The South Lancashire and Cheshire Electricity Company which is promoting a Bill for the construction of works, &c., for the supply of electrical energy for public lighting, manufacturing, tramway, mining, domestic, and other purposes in Lancashire and Cheshire, proposes to make St. Helens the centre of the works. The proposed capital is put at £2,000,000. The *Liverpool Mercury* says that the scheme includes the establishment at St. Helens of an electrical supply basis for the whole of a 17-miles circuit, including Southport in the north, Chester in the south, Eccles in the east, and all the district between, which, of course, embraces Liverpool, Birkenhead, Wigan, Widnes, Bolton, Ormskirk, Chorley, and Altrincham. St. Helens has been selected as the very centre of the Lancashire coal field, and thus affording the best site, the root idea being, in a word, to pocket the carriage on the coal, to produce on a maximum scale, to keep one of two duplicate plants running continuously, to largely utilise existing electric works as transforming centres, and to bring about co-operation with the local authorities and existing companies by supplying them wholesale at such a price as to enable electricity to be retailed through existing and extended mains at about a penny per unit. To the local authorities would be left the laying of local cables on behalf of the company, the fixing and examination of meters, and the collection of the charges to the individual consumers. The engineers of the company are Sir Frederick Bramwell and Mr. H. Grabam Harris.

Bankruptcy Proceedings.—At the London Bankruptcy Court on Tuesday, a sitting was held before Mr. Registrar Linklater, for the public examination of Claud Vautin, described as a metallurgist, lately carrying on business at 66, Old Broad Street, and residing at Upper Hamilton Terrace, St. John's Wood. The bankrupt absconded on October 27th, and it was alleged that he had obtained possession of valuable securities by trickery and fraud. An order for his prosecution was made by the Court, and he has been arrested abroad. The Official Receiver reported that the bankrupt would shortly be brought back to this country, and meantime an adjournment was necessary. No statement of affairs had yet been furnished. Mr. Alfred Beyfus represented the trustee. The hearing was accordingly adjourned.

Liquidation Notices.—Creditors of the Globe Electrical Advertising Syndicate have to send particulars of their debts or claims to Mr. T. C. Leman, St. Peter's Church Walk, Nottingham, the liquidator, on or before January 31st.

Business Announcement.—Mr. Leonard Dakin, designer of electric light fittings, &c., has recently taken up the manufacture of this line of work, and is at present turning out some good fittings at his works at Malden Place, Kentish Town, N.W. Owing to the continued increase of business, the office and studio at 41, Caversham Road, N.W., will shortly be removed to more spacious premises, where a fittings showroom will be open for inspection.

Change of Address.—Messrs. L. Gardner & Sons have removed to Barton Hall Engine Works, Patricroft, Manchester.

Christopher and Others v. National Telephone Company.—In the Queen's Bench Division on Friday last, before Mr. Justice Lawrance and a special jury, this case was heard. Mr. Moyses, in opening the case, said that the action was brought to recover damages for trespass committed by the defendant company extending over no less a period than 14 years, and which had existed unknown to the plaintiffs, for they were under the impression that the company being termed "National" had something to do with the State and had the right to do what it had done. It was only in the beginning of the present year that the plaintiffs became aware of their rights and the writ was issued on April 13th. The facts were that there were no less than 546 wires in strands or cables passing over the plaintiff's house in Assam Street, Whitechapel, and at the back of the house there were two huge poles which were put into the ground to a depth of over 6 feet. One pole was put there 14 years ago, and the second one seven years ago. One was only about 12 inches from the back wall of the house, and the other 14 inches. These poles were subject to oscillation during wintry weather, and had a disintegrating effect on the adjoining property. Three years after the first pole was put there there appeared a rent in the wall. That had been stopped up two or three times, but it had reappeared again, and other mischief had been done. Mr. Roskill, for the defence, said he would call evidence to show that the cracks were in the wall 14 years ago, and were much the same now as they were then. After considerable evidence had been given the jury found for plaintiffs, awarding the owners £45 and the occupier £5.

Concentric Wiring.—With reference to our article last week regarding the installation of electric light and power at Messrs. Fuller's new factory, Messrs. J. D. F. Andrews & Co. inform us that the wiring of this installation contains the most recent improvements in their concentric system. This differs very materially from their previous methods and is distinguished from them by its title "security concentric." These improvements lie chiefly in the joints and outlets. One is able to dispense with rubber and tape tappings, and also access may be easily obtained to the interior of any joint or outlet for testing or other purposes without injury thereto.

The General Electric Company's New Showrooms.—The new showrooms of the General Electric Company, Limited, at Victoria Bridge, Manchester, were formally opened on Tuesday, the guests being received in the fittings room, which contained a pleasing variety of fittings for ceiling, wall, and table lighting. A large company of ladies and gentlemen assembled to luncheon to wish success to the company in their new premises. Among those present were Alderman Robinson, who replied for the visitors: Mr. Clirehugh, who proposed the health of the company; Alderman Howard, and Mr. Isidor Frankenburg, who proposed "The Ladies" in a distinctly humorous speech, to which Mr. Eckstein replied. The visitors were then conducted through the various departments of the new premises, which are an ornament to an otherwise uninteresting street. It is the intention of the management that the public generally should be able to call and see for themselves the fittings which the contractors purpose using, and certainly the fittings room is admirably adapted for showing them to the best advantage. Mr. Gustav Byng was unfortunately absent through indisposition, so Mr. Max Byng did the honours, proposing the loyal and patriotic toasts and "The Visitors." The buildings, when finished, will be fitted up for exhibiting in working order every type of electrical apparatus supplied by the company. In the large model room will be practical applications of electric motors, showing their adaptability to all industrial and domestic purposes, including the driving of every kind of machinery, tools, and other illustrations of electric transmission of power. In the basement is the packing room, the engine room, and a large room for showing the application of electric motors driving machinery. There is a 50-H.P. high speed, compound non-condensing engine, coupled to a 2-pole dynamo of the company's own make. This will be used for lighting the building and driving electric motors. There are two electric lifts, one for passengers and the other for goods. The power for driving these lifts is derived from an electric motor of the company's make, the armature shafting being coupled direct on to the worm shaft of the winding gear. On the first floor is a very large showroom for the display of electroliers and brackets.

Electric Cranes.—At the last meeting of the Southampton Harbour Board the Works Committee reported the receipt of a report from the electrical engineer in regard to the official trial of the four electric cranes, when all the requirements as to speed and power were fully tested. The official tests were in every way satisfactory. In moving the adoption of the report, Alderman Bone said the electric cranes had worked very satisfactorily since their inauguration.

Electricity for Mines' Drainage.—Mr. Howl, engineer to the South Staffordshire Mines' Drainage Commissioners, has reported to that body that the Sub-Committee appointed in reference to the Tipton District engineering scheme have given instructions for the best available design or designs for a semi-portable pump for mines' drainage purposes to be drawn out and laid before the Committee at their next meeting. The proposal to borrow £10,000 at once for the gravity works, and £10,000 for electric pumps upon the surface when electricity is available, was approved, and the chairman and general manager were empowered to take the necessary steps with a view to the suggested arrangement being carried out.

Electric Ferry for the Thames.—In the next session of Parliament, power will be sought to incorporate a company to construct a ferry, to be worked by electricity or other power, on submerged rails, across the river Thames, with roadways and approaches thereto for the passage of vehicles, foot passengers, animals, and general traffic, with generating station and electrical or other machinery and appliances. The ferry, as proposed, will run from a point at or near the site of Brewhouse Lane, one chain or thereabouts to the west of the Ship Hotel, terminating in the parish of All Saints', Poplar, at or near the western boundary of the Island Gardens. It is proposed to take power to sell or lease the undertaking, or any part of it, to the Corporation or the London County Council, or any corporate body, or to make agreements with such authorities with respect to the construction, management, and maintenance of the undertaking.

The Elieson-Naylor Controller.—This apparatus, for use on motor carriages, which was described in our issue of July 29th, 1898, is now being made under license from the patentees by Messrs. William G. Temple & Co., of Kentish Town Road, who keep a stock of the standard size controller which is suited to ordinary road car purposes. Larger sizes and special forms are made as required. Messrs. Temple are devoting special attention to the manufacture of the gear and accessory apparatus for motor purposes.

Holiday v. National Telephone Company.—In the Court of Appeal on Monday, composed of Lords Justices A. L. Smith, Rigby and Collins, a motion was made on behalf of the plaintiff in Holiday *v.* National Telephone Company, Limited, for leave to appeal from an order by Justices Grantham, Wills and Lawrance, sitting as a Divisional Court, reversing a judgment entered in the City of London Court in favour of the plaintiff. The circumstances of the case were recorded in our last issue. Their Lordships now gave leave to appeal.

India-Rubber.—Messrs. Jackson & Till's December statement shows the total stocks of rubber in the United Kingdom as follows:—1898, 2,294 lbs.; 1897, 1,156 lbs.; 1896, 2,138 lbs.

Intended Dividend.—December 16th is the last day for receiving proofs for the intended payment of dividend in *re* London Provincial Electrical Company, 110, Cannon Street, E.C. Liquidator, Mr. S. Wheeler, Carey Street.

List.—Mr. Chas. Auriol, of Clapham, sends us a list of his windlass for suspending arc lamps, and his special pulley for metallic cable.

New Magazine.—We have received the first number of the *Engineering Times*, a sixpenny monthly magazine. The December issue contains articles on "The Future of Acetylene," by Prof. Vivian B. Lewes, F.I.C., &c.; "The Advance of the Friction Clutch," by Walter Bagshaw, M.I.M.E.; "High Speed Steam Engines," by W. Norris, A.M.I.C.E., M.I.M.E.; "Stern Wheel Steamers," by E. C. Amos, M.I.M.E.; "Rope Driving," by C. W. Ironmonger; "Modern Machine Tools," by E. C. Amos, M.I.M.E.; "Progress in Electrical Transmission of Power," by Walter F. Jones, M.I.Min.E.; "Submarine Engineering and Diving Operations," by R. H. Davis; "The Construction and Use of the Pulsating Pump," by John B. Foxwell; "Water Gas as a Commercial Product," by the editor, Mr. Ben. H. Morgan.

Power Distribution.—At a meeting of the Dudley Town Council on Tuesday, the town clerk was instructed to oppose the application of the Midland Electric Corporation for Power Distribution, Limited, for a provisional order to supply electricity for public and private purposes within the borough. The West Bromwich Electric Lighting Committee have also recommended the Council to instruct the town clerk to oppose the application as affecting West Bromwich.

"Riker" Electric Carriages.—Messrs. Shippey Bros. send us a sheet of new designs in self-propelled electric carriages and motor cars on the "Riker" system.

The Scotch Water-Power Scheme.—Among the more important proposals to come before Parliament next session in the form of private bills, is one from Scotland, promoted by a wealthy syndicate, to authorise a scheme for conveying the waters of Loch Ericht, Inverness-shire, to the top of Loch Leven, on the West Coast of Scotland, at a point about seven miles above Ballachalisch. The object, according to the *Daily Telegraph*, is to secure at that point sufficient water-power to generate about 40,000 electrical horse-power. This it is proposed to accomplish by means of a fall of 1,100 feet. The scheme is estimated to cost between £1,000,000 and £1,500,000, and when it has been carried out there is every reason to believe that a number of extensive factories in connection with chemical industries will be established at Loch Leven. Of late years it has been found that, owing to the abundance of water-power available in America and Germany for the purpose of generating electricity at a very cheap rate, the British chemical manufacturers, particularly those who make chloride of potass, have been almost entirely driven out of the market by foreign competition. One great advantage of the Loch Leven site is that vessels drawing 14 feet of water can get up to the top of the loch at high tide, so that the raw material required for the factories, as well as the latter's finished produce, could be conveyed by water instead of rail, and this, as is well known, means cheaper rates. The proposed scheme will, it is believed, cause certain large chemical manufacturers, who had been contemplating the transference of their works from this country to the United States, to revise their plans. As to the Parliamentary prospects of the Bill, it is considered probable that the riparian owners, especially those on the Tay, will offer some opposition, as the water proposed to be impounded flows into the Tay valley, but the promoters are confident they can overcome this difficulty by raising the level of the ground in one of the contributing valleys, so as to intercept the storm water, by which means the engineers say that they will be able to give a flow of water during the dry season twice as great as that which now enters the Tay, whilst they will also do much to mitigate the damage annually caused to the banks by the flood in the wet season. It may be added that the particular area affected by the scheme is within what is called the chief water rainbelt in Scotland—that is, the zone in which the largest rainfall is experienced in all seasons.

W. H. Wilcox & Co.—At the Smithfield Show this firm has an exhibit of engineers' tools and general engineers' stores, steam fittings, roller bearings, &c.

ELECTRIC LIGHTING NOTES.

Amblecote.—At last week's District Council meeting a committee reported that a short time ago they met in consultation with Mr. Addenbrooke, the engineer, and Mr. A. L. Lowe, the solicitor of the Midland Electric Supply Corporation, Limited, when a schedule of the prices proposed to be charged by the corporation for the supply of electricity in Amblecote was submitted. The chairman said so far as he could see there was no reason why they should oppose the Midland Electric Corporation's proposal. The report was adopted.

Barrow.—At Monday's meeting of the Council it was stated that the Electric Light Committee has decided to use arc lamp-posts similar to those of Edinburgh, at a slightly increased cost. It is hoped that the central part of the town will be shortly supplied with current.

Belfast.—A number of persons whose premises are wired are pressing for a connection to the public mains, and the Electric Committee has now resolved: "That the connections be made in the cases of all applications already granted, on the understanding that if necessary the pressure of supply may be lowered to meet the extra demand pending the erection of the additional plant, delivery of which has been delayed beyond the contract time, owing to labour difficulties the contractors have had to contend with."

Bermondsey.—The Vestry on Monday considered a report of the Lighting Committee, intimating the intention of the London Electric Supply Corporation to lay high and low pressure mains in Southwark Park Road. It was resolved to disapprove of the laying of the distributing mains on both sides of the streets. The Vestry decided to oppose the application of the County of London and Brush Provincial Electric Lighting Company for a provisional order for Bermondsey.

Bexley.—The Bexley District Council have passed a resolution authorising the clerk to apply for a provisional order.

Blairgowrie.—Efforts are being made to form a syndicate to introduce electric lighting. Water-power utilisation is spoken of in connection with the scheme.

Bognor.—The Urban Council held a special meeting last Friday, and carried a resolution to apply forthwith for a provisional order.

Chelmsford.—The Town Council has decided to make a strong representation to the Chelmsford Electric Lighting Company, Limited, in regard to the unsatisfactory lighting of the public streets and the inefficient private supply.

Chelsea.—Last week the Vestry held a special meeting to confirm its resolution to apply for a provisional order to supply electricity to Kensal Town, an outlying portion of the parish. The surveyor, Mr. T. W. F. Higgins, A.M.I.C.E., submitted a long report, in which he indicated a compulsory area, and mentioned that for dealing with this, and providing a 120-kilowatt plant, with reserve power in case of repairs, the estimate would be—site by the canal, £3,500; buildings, chimney, yard paving, foundations, &c., £2,750; boilers, generating plant, electrical apparatus, £4,000; mains and street work, £3,250; total, £13,500. It was possible that if the installation was worked by means of a "Dowson" gas plant, such as was used at Leyton, the total cost might not be more than £12,750. This was the lowest sum for which a proper start could be made with any prospect of future success, and to obtain the future success, the expenditure of £13,500 must only be a stepping stone to the £36,000 which he had previously estimated for a fairly complete installation at Kensal Town. After discussion, the confirmatory resolution was defeated by 23 votes to 22.

Coatbridge.—The Old Monkland School Board has appointed a committee to consider the question of electric lighting for the Coatbridge High School.

Colchester.—The electric current was supplied for the first time on 1st inst. from the Corporation station. The present plant is capable of supplying 4,500 lights, and room has been provided in the station for increasing the number of engines and boilers when necessary. Already applications have been received for close on 3,000 lights. The engines are direct coupled to the dynamos, and can be run either condensing or non-condensing. The water for condensing is obtained from a well sunk at the bottom of the exhaust

pit, and the water for the boilers is contained in a 17,000 gallon tank, and supplied from the Corporation waterworks. The present batteries, when charged, can supply 4,500 lights for three hours, so that in case of a breakdown the light would not be suddenly cut off. The engines and boilers are supplied by Messrs. Davey, Paxman and Co., tank by Messrs. Stanford & Co., and the heating pumps by Messrs. Mumford. The formal inaugural ceremony will take place early next year, by which time the station will be in complete order.

Darlington.—The Town Council has appointed a sub-committee to deal with the various questions in connection with the electric lighting of the borough.

Dudley.—The Railway, Tramway, and Electric Lighting Committee of the Town Council issued last week a report stating that, having discussed the terms of the agreement to be entered into between the Corporation and the British Electric Traction Company, with reference to relaying and electrically equipping the line from the railway station to the borough boundary, they had instructed the town clerk to draw such agreement for perusal by the company. The town clerk was also instructed to take all necessary steps to oppose the application of the Midland Electric Corporation for Power Distribution to the Board of Trade for a provisional order.

East Barnet.—Last week the East Barnet Valley Council decided to apply for a provisional electric lighting order.

Eccles.—The electricity works are now ready to commence operations, and they will be formally opened next week.

Exeter.—In its latest report to the Council, the Electric Light Committee shows the growth of the electricity supply business under the Council by the following figures:—Capacity of plant at July 1st, 1895, 7,400, at present date 14,100 lamps; lamps connected 7,800, against 14,000 (nearly); number of consumers, 150, against 297, showing that the size of the undertaking had been practically doubled during the above period. The electrical engineer pointed out that the delay in obtaining machinery, transformers, cables, &c., made it more and more difficult to keep up with the demand, and he suggested that early steps should, therefore, be taken to provide for the future, and to add to the present capacity of the plant while the larger scheme was under consideration. The committee reported that they had decided to instruct the city surveyor and electrical engineer to further consider and report upon the different methods by which increased power and capacity could be supplied either at Countess Weir or any alternative site. Opportunity will shortly occur for securing additional land at the present works. The Council approved the recommendation.

Failsworth.—The District Council last week decided to memorialise the Board of Trade for electric lighting powers.

Germany.—According to the report of the Allgemeine Electricitäts Gesellschaft, of Berlin, for the financial year 1897-98, the company completed during the year 15 central electric lighting and power stations of a capacity of 11,500 kilowatts. At the present time they have no less than 28 stations of 41,000 kilowatts capacity in course of construction.

Grantham.—The premises of Messrs. Boots, chemists, who have opened a large establishment in High Street, have been lighted throughout by electricity. A similar movement is in progress at Messrs. Hornsby's extensive engineering works.

Greece.—Messrs. Heidemann & Co., of Cologne, are reported to have secured a contract for the electric lighting of the town of Argostoli, Greece.

Islington.—After an exciting debate, the Vestry decided, at the last meeting, to instruct the Electric Lighting Committee to advertise for firms willing to undertake the work of extending the electric light station at a cost of £22,000. In reply to questions, the treasurer stated that there were 216 arc lamps in the parish, costing £6,822 per annum, or £40 17s. 1d. per lamp, and that these had displaced 440 gas lamps, costing £1,747 per annum. At the next meeting a motion will be proposed by Mr. Stainton in favour of letters being sent to the Board of Guardians and the Local Government Board protesting against the proposed large expenditure in connection with the installation of generating plant in the new infirmary buildings. The protest is based upon the idea that the Vestry, whose mains do or will pass the buildings in question, should supply the current for the infirmary.

St. James's, Westminster.—The clerk at the last meeting of the Vestry reported the receipt of plan and notice from the St. James's and Pall Mall Electric Lighting Company of intention to apply for permission to introduce a Bill in the ensuing session to empower the company to acquire compulsorily certain property in the parish. A notice was also read announcing the intention of the Brompton and Piccadilly Circus Railway Company to introduce a Bill to authorise the extension of this railway.

Leeds.—On Wednesday the City Council had before it a resolution to "create Leeds Corporation irredeemable stock to the amount of £217,420 10s. 4d., bearing dividends at the rate of 5 per cent. per annum, such stock being sufficient to produce by the dividends thereon the annuity referred to in Section 59 of the Leeds Electric Supply Order, 1891, and to be issued or transferred to the undertakers in satisfaction of the said annuity;" also to raise and pay all additional moneys due and payable by the Corporation to the company in connection with the agreement of November 8th.

Leigh.—The Local Government Board has sanctioned the Council's application for a loan of £18,860 for gasworks extensions, and of £10,216 for the erection of electricity works.

Lewisham.—Last week the District Board of Works referred to Committee a notice received from the Blackheath and Greenwich District Electric Lighting Company of their intention to lay mains in certain streets.

Limerick.—The Board of Trade has written to the Corporation asking whether it proposes to take steps to carry out its 1892 provisional order. The Corporation has replied suggesting that the matter be left until the new Council is elected.

London.—At the Court of Common Council last week a committee reported on letters received from the Smithfield Markets Electric Supply Corporation, Limited, and the Charing Cross and Strand Electric Supply Corporation, Limited, asking for the formal consent of the Corporation to their intended applications to the Board of Trade for provisional orders for the supply of electricity within the City. It was recommended that the companies should be informed that the Corporation regretted that it was unable to give its consent to the applications. The Court agreed with the committee.

Longton.—The British Electric Traction Company has written to the Town Council, stating that it does not intend proceeding with its application for a provisional order.

Manchester.—Mr. C. H. Wordingham, the city electrical engineer, has written to the Manchester papers showing how the dispute in the engineering trades is to blame for the low pressure of the current now being supplied to consumers. Plant on order is many months, and, in some cases, a year or more overdue. Mr. Wordingham says:—"The Electricity Committee of the Manchester Corporation have now on order two large electrical generators, each of 2,500 H.P., and capable of supplying together 100,000 lamps. One of these was guaranteed to be running by October, 1897, the second by September, 1898, and neither of these is yet at work. In spite, therefore, of the foresight of the Committee in ordering plant well ahead of the probable demand, we still have no more plant capacity than we had in March, 1897, and the consequences are now being experienced by our consumers. Further than this, 10 additional boilers, equivalent in steam-raising capacity to the number now fixed, are also much overdue, and we are thus doubly handicapped. For the last two evenings (the letter is dated December 1st) the pressure on the electric mains has been as low as 87 volts on Monday for about one hour, and yesterday for about two hours. Everything that is possible to be done has been and is being done. The boilers are being forced to a very large extent, and the whole of the existing plant is greatly overloaded. Every portion of our machinery is in thorough repair, and nothing has been neglected on our part, the trouble being solely due to contractors not keeping favour with the Committee. . . . . I have every confidence that in about a fortnight from this date we shall have six new boilers and one of the new generators at work, and in the meantime can only ask our consumers to bear with the low pressure with as much patience as possible." Consumers are asked to dispense with as many lamps as possible between the hours of 4 p.m. and 6 p.m.

Newark.—The Corporation has recently considered proposals by two companies re electric lighting, but has decided to keep the powers in its own hands. It is too late to apply for a provisional order this year, so the matter will come up next year.

Nottingham.—It is stated that the past year's trading of the Electricity Department of the Corporation shows a profit of £7,067 7s. 5d. After contribution to sinking fund, repayment and interest, the net revenue works out at £3,502 9s. 10d.

Partick.—A deputation of Partick Commissioners last week met the Electricity Committee of the Glasgow Town Council in support of the proposal to extend the supply of electricity for lighting purposes to Partick.

Pemberton.—The District Council has appointed a deputation to visit the Whitehaven electricity works and report.

Penzance.—The Town Council held a special meeting on 5th inst. and passed a resolution deciding not to consent to the proposal of Messrs. Edmundsons' Electricity Corporation to apply for a provisional order, but to take steps to secure powers for themselves. The Lighting and Highways Committees are to jointly consider the subject and bring up a scheme.

Plymouth.—Several tradesmen have put in private installations, and as gas is so cheap, 1s. 9d. per 1,000, the cost of current, where gas is the motive power, works out very low. In every case where this system has been tried it has, so it is said, given satisfaction. The Corporation works are making progress, and may be completed early in the new year.

Reading.—Although the Electric Lighting Company proposes to change its system from 100 volts to 200 volts, the Free Library Committee will stick to the old pressure, as in their opinion there would be an outlay necessitated which would not result in any particular advantage.

Redditch.—With reference to our paragraph under this heading last week, Mr. J. A. McMullen, consulting electrical engineer, writes as follows:—"In justice to Messrs. Easton, Anderson and Goolden I must ask you to correct the paragraph which appeared in your last issue. The business is being carried on and has not become bankrupt. No definite contract had been entered into between Messrs. Easton, Anderson & Goolden and the Redditch Council, although originally it had been intended to give them the order as soon as the Local Government sanction had been obtained. However, the matter was reconsidered, and the order has gone to Messrs. Johnson & Phillips because they agree to bind themselves in heavier penalties to deliver in a shorter time."

Shoreditch.—The chief engineer, Mr. Russell, has been authorised by the Vestry to ask for tenders from three firms for two spare armatures, one of 66 kilowatts, and the other of 33 kilowatts capacity. It has also been resolved to order additional cables at a cost of £550. Additional mains are to be laid in Cropley Street at a cost of £239.

Stockton.—The electric lighting works are being rapidly pushed forward, and may be completed next summer.

Sutton (Surrey).—The scheme of the Electric Power Distribution Company is to establish works in Sutton and supply current there, also to obtain powers for supplying Carshalton.

Turkey.—The Berlin correspondent of a London daily says that it is reported that a German firm of electricians obtained an iradé from the Sultan in 1889 to light Smyrna with electricity, but up to the present every possible difficulty was placed in the way of the installation. It is now probable that the German Ambassador in Constantinople may make representations in support of this claim in opposition to the concession granted to Sir Ellis Ashmead-Bartlett.

Wallasey.—At last week's District Council meeting several members complained of the "erratic doings of the electric lamps," and in reply Mr. Joyce, chairman of the Committee, said he hoped they would soon have an ample supply of current.

Walmer.—The Walmer Urban District Council have instructed their clerk to communicate with the Deal Town Council upon the desirability of joining together in a scheme for obtaining a provisional order for lighting the district with electricity.

Wednesbury.—The Town Council has this week decided to engage Mr. F. J. Warden-Stevens, to report upon a scheme of electric supply.

Wellingborough.—The Highways, Lighting, and Water Committee is to obtain an estimate of the cost of destroying the refuse, and, in connection therewith, generating electrical energy.

West Bromwich.—The Electric Lighting Committee have reported to the Town Council that, on September 22nd, the British Electric Traction Company, Limited, wrote and offered to take an assignment of the electric lighting order which the Corporation had obtained, and subsequently they wrote submitting certain conditions as a basis for the discussion of the proposed arrangement; but after carefully considering the conditions, the members could not advise their acceptance.

Whitechapel.—The Electric Lighting Committee of the District Board recommend the adoption of the plans of Mr. Arthur Wright for the supply of electricity by means of an installation on the board's premises in George Yard and Angel Alley, at a cost of £60,500, and that arrangements be also made for reconstructing the dust destructor for generating steam power in connection with the installation. It is also proposed to apply to the London County Council for the necessary loan.

Winchester.—The Board of Guardians adopted some weeks ago a report of the Visiting Committee in favour of lighting the Workhouse by electricity, and a tender for the installation was accepted. Some members were not present when this decision was arrived at, and last Saturday the matter was re-opened and the resolution rescinded, so that the Workhouse will not be lighted by electricity at present.

Wolverhampton.—Applications for current are coming in so rapidly that it has now been found necessary to partially cut off the illuminant in at least one of the public buildings, in order better to meet the requirements of private customers. It is anticipated that before the end of the year, or at all events during Christmas week, the maximum load to be put upon the generators, will show an excess of at least 50 per cent., compared with that of the corresponding period 12 months ago. The largest individual customers are the proprietors of the new Empire Theatre, opened this week. In July last the order for the lighting of this establishment numbered 412 lamps, averaging 16 C.P., but there are now nearly 820 lamps. As one means of relieving the strain on the resources of the lighting station, and also in order to be prepared for any emergency that may arise, it has been decided by the Corporation Markets Committee to have the old gas fittings in the Market Hall restored, so that if necessary the large arc lamps which supply the general lighting of the building may be temporarily cut off (say for an hour or so) without serious inconvenience to the stall-holders. The incandescent lighting circuits on the stalls will not be interfered with. It is not anticipated that the above steps will really be necessary, but in the interests of their consumers, the Lighting Committee are taking every precaution.

Worthing.—The Electric Lighting Committee of the Town Council are conferring with Mr. Monkhouse on the cost, advantages, and expediency of erecting a refuse destructor in connection with the electric lighting works, the cost and most desirable method of providing the water supply which will be required for the works, and the cost and best method of lighting the street lamps in the borough.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Accrington.—The Corporation has been formally approached with a view to their acquisition of the system worked by the Accrington Steam Tramways Company. The neighbouring towns of Haslingden, Rawtenstall, and other places have to be consulted, and if the proposal is entertained electric traction will be considered.

Baker Street and Waterloo Underground.—According to the *Daily Chronicle*, the erection of staging at mid-river and other preliminary work in connection with this electric railway is completed. A shaft has been sunk, and tunnelling operations will soon commence. Messrs. Perry & Co., of Waterloo Road, have the contract for the line.

Bradford.—A Bradford paper says that on the evening of the 30th ult., through the failure of the electric current for some reason, the electric trams to Great Horton were brought to a standstill and the arc lamps were extinguished.

Brighton.—At the last meeting of the Town Council, the General Purposes Committee reported that they had had under consideration a resolution passed by the Council with reference to the appointment of a Special Committee for the purpose of conducting the business of preparing and managing tramways for the borough. They had come to the conclusion that the basis of the formation of the committee should be the representation of each ward in the borough, and to permit of this being done, the committee recommended the Council to increase the numbers from 12 to 14 (in addition to the Mayor). It was proposed, however, that the committee should be constituted on the same lines as other committees of the Council, and that the number of members should be 12. On a division, this amendment to the committee's recommendation was carried by 22 to 19, and Aldermen Reeves, Sendall, and Sir J. Blaker, and Councillors Buckwell, Stafford, Carden Blaker, Wilson, Galliers, Holloway, Wallis, and Swift were elected to serve on the committee.

Bristol.—An unexpected hitch has occurred in the arrangements for the new system of electric traction with which Bristol is being supplied by the tramway company, and it seems possible, unless the civic authorities vary their requirements, that an appeal to the law courts may be necessary in order to decide what are the respective rights of the city and the company. The matter has arisen out of resolutions by the sanitary authority as to the mode of carrying the trolley wires. On October 26th the Sanitary Committee resolved that the company be required to use centre posts with brackets in streets 40 feet wide and upwards between the kerbs, but that it was not desirable that centre posts should be used in narrower streets. On November 2nd a further resolution allowed the company to use the span-wire system with double poles in streets less than 40 feet wide, but it provided that where the thoroughfare between the kerbs was less than 30 feet, the company should use either single poles with bracket arms or span wires attached to the adjoining houses with rosette supports. At a later meeting there was a variation of these conditions, and the company were informed that centre poles should be adopted in all streets of 36 feet and upwards in width, and single side poles and bracket arms (except in cases where the company could arrange to carry span wires by rosettes) in all streets less than 36 feet. On December 1st the city engineer presented to his Committee a schedule of streets, but said that while the company seemed to agree to the proposal for centre poles in most of the streets named, they made a number of exceptions, and threw doubt on the power of the Corporation to restrain them. This intimation led to a discussion as to what the powers of the authority were, and the clerk (a solicitor) advised the committee that if the company on their plan showed a pole in a certain spot, the committee had a right to approve or otherwise. A long communication was read from the company. The company thought it unfortunate that, having presented their scheme providing for the general use of the span-wire system, the committee had, upon a reconsideration, expressed themselves against that system, and suggested others. The company felt that the committee had some misconception as to the company's statutory rights. The Corporation were not entitled to require the wholesale exclusion of poles, which the company deemed necessary. A requirement by the committee to place the posts in positions between the tracks, as a condition of the committee's approval, would, if enforceable, entail the entire removal and reconstruction of the tramways, whereas the Company's Act clearly authorised the adaptation of the present tramways, and the location of poles in relation thereto as the company considered convenient. The directors of the company, however (without prejudice to their legal rights), desired to meet the wishes of the committee as far as possible. They urged that in selecting the span-wire system in preference to the bracket system, they were influenced by considerations not only of appearances, but of the greater facilities in actual working, their views with regard to this being based on their own experience at Kingswood (bracket system) and Staple Hill (span-wire system) sections. The span-wire system had been selected by various local authorities with which the managers of the Bristol lines are concerned in the West-end and suburbs of London—about the same extent of street-length as was under discussion in Bristol. Moreover, the span-wire system was particularly suitable to the varying widths of Bristol's streets. The company added to their letter three schedules of streets. In the first of these they said the tramways had been recently relaid with girder rails, and in some cases were bonded for electrical working. The rearrangement in these streets would cost £5,000 or £6,000 and seriously dislocate traffic. The second schedule

included streets so short as to make it objectionable to change to the centre-pole system. The third schedule contained streets where the relaying had not been started, and where it would be possible to open out the lines for centre-pole equipment. This third schedule embraced thoroughfares of two-thirds of the entire schedules; the extra cost of opening out would be £4,000. The company said their agreement to use centre poles must be limited to the third schedule. The company offered to meet the committee on this schedule if the committee would approve the rest of the scheme as submitted, but this offer did not tempt the Committee to settle, and they resolved to adhere to their determination to require central poles in certain thoroughfares, so that the powers claimed by the company might be tested.

The Board of Trade have recently confirmed an order, entitled the St. George and Hanham Light Railways Order, 1898, authorising the construction of a light railway from Summerhill Road, in the city and county of Bristol, to Hanham, in the parish of Kingswood, in the county of Gloucester.

Cheltenham.—On 30th ult. the plans and estimates of the proposed tramway from Cheltenham to Cleeve Hill were deposited, on behalf of the promoter (Mr. T. Nevins), at the town clerk's office. The total length of the line will be a little over 5¾ miles, and the estimated cost is £46,586. The line will commence at the Lansdown Castle, or extreme western side of the town, and will finish at the post office at Cleeve Hill. The gauge is to be 4 feet 8½ inches. It is provided that within the borough the roadway between the rails, and for a foot and a half on each side of the track, is to be paved with the Karri or Jarrah wood blocks, or MacDougall's patent bricks.

Dewsbury.—The question of electric tramways for Dewsbury is receiving a good deal of attention. A company is promoting a scheme which, if carried out, would serve Cleckheaton, Liversedge, Heckmondwike, Dewsbury, and Ravensthorpe; but this the Corporation do not approve of, and they have agreed to oppose its introduction, believing that they can better serve the borough, and, with the assistance of local authorities, the outside districts also. In the meantime a special Committee has been appointed to consider the matter and report.

Dudley.—On Tuesday, at a meeting of the Dudley Town Council, the Railway, Tramway, and Electric Lighting Committee reported having held a conference with the representatives of the British Electric Traction Company, Limited, with reference to the re-laying and electrical equipment of the line from the railway station to Hart's Hill, and that the town clerk is preparing an agreement with reference to the matter.—The Mayor said that when the report of the committee was issued, the agreement had not been drawn. But the substance of it was this:—From the commencement of the Castle Hill down to the station the poles would be erected in the middle of the street. From the top of the Castle Hill to Messrs. Westwood and Wrights, the wires would be carried on the bracket system; and from there to the limit of the borough the span system would be used. On the Netherton line the span system would be used from Queen's Cross to Simm's Lane, from thence to the Fountain, it would be the bracket system, and the span system would be used on the remainder of the line. The reconstruction of the present line would be complete before the end of March, and the Netherton line would be commenced immediately thereafter.—Councillor Chambers remarked that the span system was very ugly.—The Mayor replied that he had done everything he could to secure a uniform system, but there were insuperable difficulties in the varying widths of the road.

Dundee.—When the Tramway Committee met last week the town clerk submitted a letter from Prof. Kennedy, declining the offer of the appointment of consulting engineer on the ground of pressure of other work. He also pointed out that he did not undertake any work of this kind except where he had to prepare the plans and specifications in his own office, and to be entirely responsible for them and for the work generally from beginning to end. The Committee, having considered the whole matter, were of opinion that the overhead system was the only appropriate one for Dundee, and they therefore instructed the burgh engineer and the electrical engineer to prepare plans and specifications (1) for the application of electric power to the Perth Road tramways, and (2) for the construction and application of electric power to tramways to be constructed on the Broughty Ferry route, and to report such plans and specifications, with estimates of cost, as early as possible. It was also resolved to remit to Mr. Brownlee to negotiate with the tramway company for the purchase of the plant, with a view of obviating the cost of arbitration. To Mr. Brownlee was also remitted some time ago the duty of arranging for the taking over of the buildings, &c. The work will be prosecuted with all despatch, the idea of the Corporation being to prepare the lines for the electric cars prior to taking over the whole system in June. Another letter has been received from Prof. Kennedy, in which he states that he reported to the Corporation of Edinburgh some years ago "that all the underground systems up to that date were more or less of an experimental type, and that if they were to adopt either or any of them they would have to take their chance as to whether they would be an ultimate mechanical success or not." Continuing, he says:—"Within the last few years there had no doubt been a very considerable advance in the use of underground or conduit systems of electric traction. I understand that there is a very successful conduit system now at work in Brussels. There are various contact systems without a slot which are under experiment at present, but I think it cannot be said that any of them have as yet passed the experimental stage. None of them have really been practically used in tramway working. It is stated by tramway people that the conduit system costs in working about ½d. per car mile more than the overhead system. I do not know whether there exist really sufficient data to justify this statement. My own impression is, that the two systems would be practically the same in cost of working. But there is no doubt that the conduit system will be very greatly more expensive in first cost, and in the case of a Corporation taking it up for themselves, it is no doubt for them to find out whether in their particular case the additional convenience and sightliness of an underground system is worth the very large additional capital expenditure. I suppose that to answer a question like this for Dundee, it would be really necessary to have comparative estimates made, and one ought also to know, as far as such a thing can be known, the extent of the objection which your people would have to overhead wires. In case of small towns where additional capital expenditure would be very serious, and where the traffic cannot be expected to pay except on a minimum of capital, there is no doubt that the overhead system is the only one which is practically feasible, but in the case of a large and wealthy city like Dundee, it has become a matter for serious discussion now that it is possible to see tramways successfully running worked on an underground system and without a trolley wire."

When a minute came before the Town Council last week recommending the adoption of the overhead trolley system of haulage for the trams, a member thought they were going too quickly and should "work away with steam and horse haulage for a time." He moved accordingly, and the motion was seconded. Ex-Provost Brownlee moved the confirmation of the minute, and in doing so said that they could hardly be accused of rushing the question, seeing that it had been under consideration for 18 months. He proceeded to explain why there should be no delay. They had, under the agreement, to pay a considerable sum to the Tramway Company. Was there any reason for their taking over the lines if they were not to improve the system? They had to take over the tramways on June 1st, and they must have their arrangements made before beginning, and it was of the very first importance they should have a resolution come to immediately. Was there any person there—assuming the conduit system was ultimately proved to be a success—was there any person in that room who would recommend that the conduit system be laid down when informed that it cost from £5,000 to £6,000 a mile more than the overhead system? However, assuming that, within a few years, the conduit system was proved to be a success, what did they lose? It was a comparative trifle. The posts and the wires were all they could lose. The rails, boxes, and feeders would be all there as before, and all they would do was to remove the posts to some of their suburban lines. Within the first year alone, with the saving on interest and working expenses, he thought they would have more money than would lay down a conduit system in the centre of the city after it had been proved to be a success. Was there any reason, then, for hesitation at all? After discussion, the ex-Provost's amendment was carried by 23 votes to 4.

Electric Car Fatality.—On 29th ult. an inquest was held on the body of a labourer named Dunne, who jumped off an electric car at Dublin and was run over by the trailer attached to it. The jury found that the officials on the cars were not to blame, and they expressed disapproval of the use of trailer cars in the city.

Exeter.—The Finance Committee last week recommended the Council to take steps to purchase the tramway undertaking, with a view to extending it and adopting electric traction; also to oppose the proposed provisional order of the Exeter Tramways Syndicate. The City Council passed the resolutions, and directed the committee to immediately open negotiations with the owners of the tramways, with a view to early purchase.

Gillingham.—At the District Council meeting on the 1st inst. a letter was received from the Light Railway Commissioners saying that they proposed to make an order for the light electric railway scheme in the terms of the draft submitted. The Council was to consider the draft yesterday.

Glasgow.—Last week the Tramways Committee resolved to extend the trolley system of cars from Glasgow Cross to Govanhill. An experiment with the conduit system will be made in some other part of the city.

Great Grimsby and Cleethorpes.—In their latest report to the shareholders, the directors of the Provincial Tramways Company state that they have given notice of a Bill in Parliament in the ensuing session to enable the Cleethorpes section of the Great Grimsby street tramways to be extended and worked by electric traction, and to enable the company on the one hand and the Corporation of Great Grimsby and the Cleethorpes local authority on the other hand to enter into agreements with regard to the postponement of the dates of purchase.

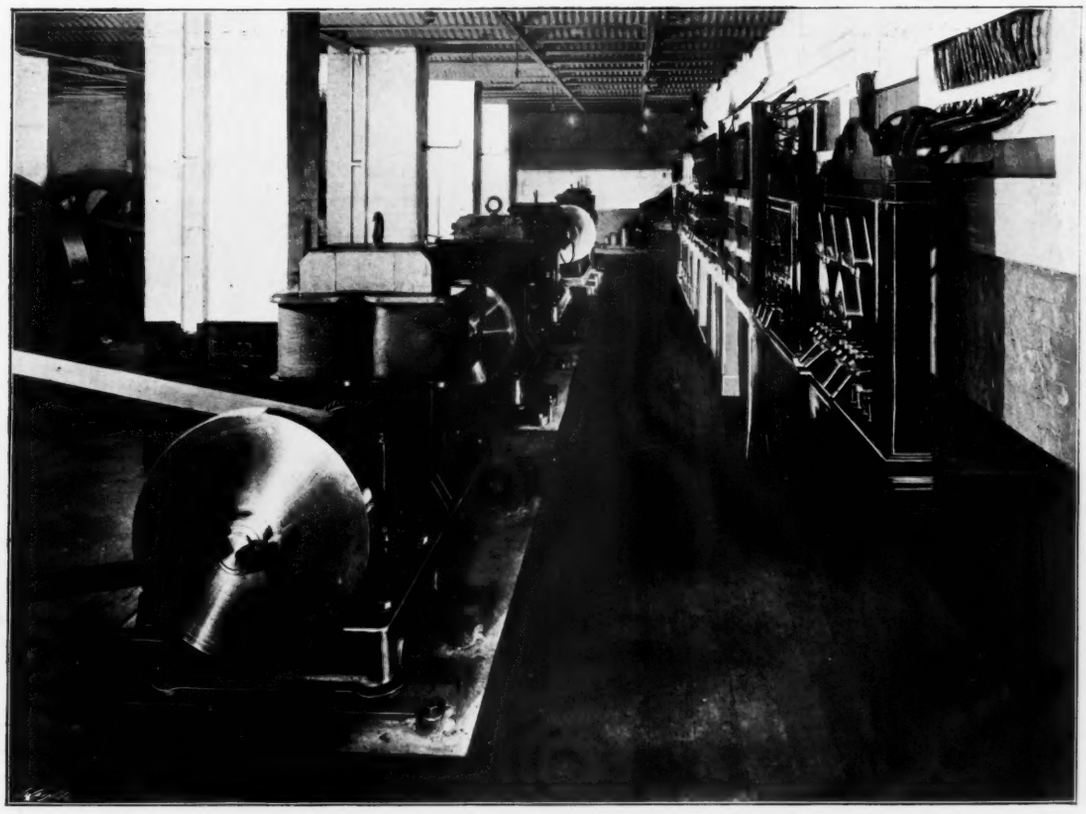
Hastings.—At last Friday's Town Council meeting, a letter was read from the British Electric Traction Company, intimating that it is their intention to promote next session a Bill for the purpose of providing tramway communication between St. Leonards and Bexhill. The Bexhill Council had given consent to the proposed line, and Lord De la Warr and other landowners had also assented to the company's proposals. The company were of opinion that the proposals of the Corporation did not clash with their scheme, but, on the contrary, thought considerable advantage must accrue from a physical junction between the two lines. The company offered to work the proposed Corporation tramline on lease. It was proposed that the company be informed that the Corporation did not consent to the scheme, and would therefore oppose the same; but an amendment, referring the matter to the committee who have the tramway question under consideration, was carried by 19 to 15.

(*Continued on page* 869.)

A LARGE ISOLATED PLANT.

Whatever demerits isolated plant may possess in these days of almost universal public supply, there are many conditions under which it renders excellent service. One of the largest and most interesting examples of an isolated plant is that of the Royal Agricultural Hall, Islington, and an idea of its magnitude may be obtained from the illustrations accompanying this article.

Some amount of skill has been necessary in arranging the plant to the best advantage, for even in so spacious a building as the Agricultural Hall it is not easy to find space that would accommodate an extensive array of engines and dynamos, especially when the plant is belt driven and the drive a fairly lengthy one.



General View of Dynamos.

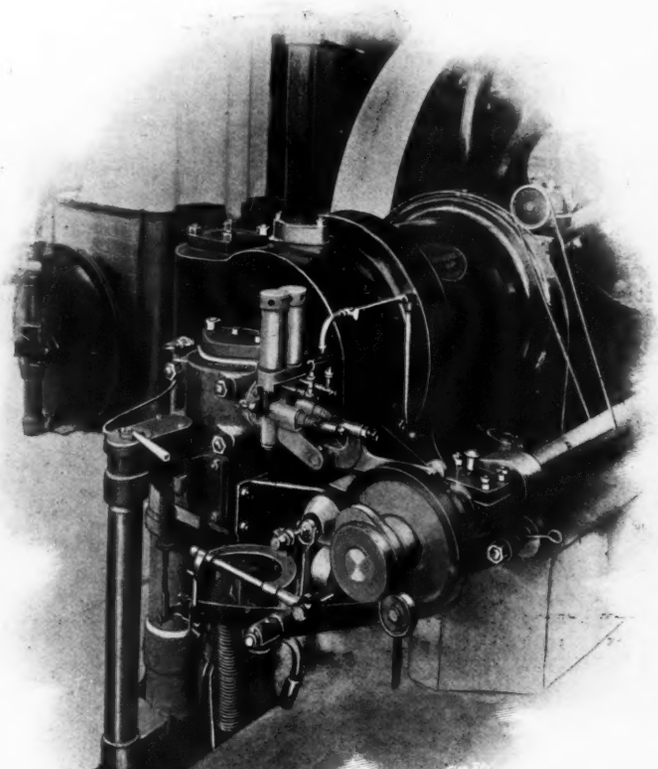
The engine and dynamos are placed in a specially reconstructed room under the floor of the hall. As the size of the plant has gradually increased, structural alterations have been rendered necessary, but the contractors have made admirable use of the space at their disposal.

The dynamos are gas driven, the engines being of the well-known Andrews Stockport type. We have, on different occasions, given the chief features of this engine; but as the most recent additions to the Agricultural Hall plant comprise some new and interesting details, it will be useful to record them. There are five sets of plant, the engines each developing about 63 brake horse-power. Needless to say, the scavenging principle is employed, though the exhaust pipes in no case are especially long. One of the most marked improvements of recent times in gas engine practice is the use of a double ignition-tube bracket. The advantage of this is that if a tube gives way when the engine is running the second tube can be instantly put into action, thus avoiding the stopping of the engine and the consequent extinction of the lighting. Each engine is provided with an automatic self-starter and the usual form of high speed governor that generally accompanies this type of engine.

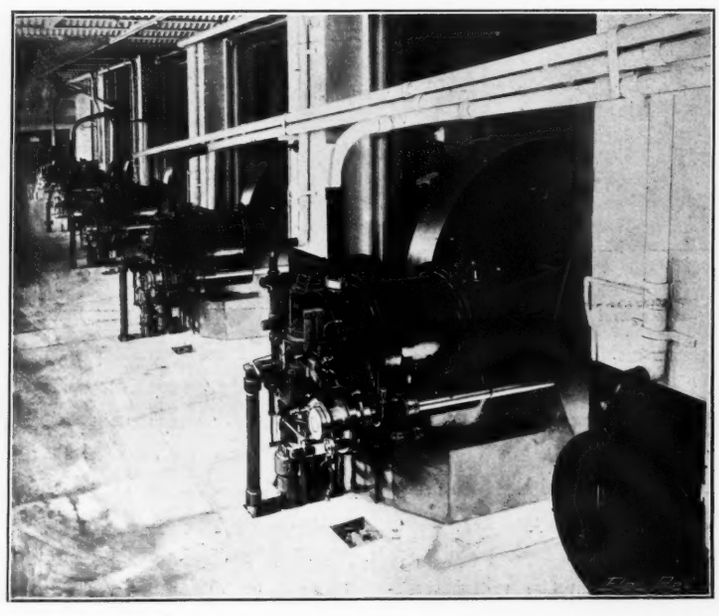
The engines are coupled by belts to five shunt wound generators of Messrs. Crompton & Co.'s manufacture, each having an output of 380 amperes at 110 volts. The armatures are of the drum bar type pattern, and the machines are provided with a third bearing. Each is fitted with a heavy fly-wheel and split bearings with self-oiling oil rings and gauge glasses. In connection with two of the machines a shunt wound "booster" is built on the same shaft for the purpose of raising the pressure to charge the accumulators, and they are connected in such a way that this can be done whilst keeping 100 volts on the lighting circuit.

The switchboard is of enamelled slate in 10 sections, and is supported and fixed by means of a wrought-iron frame. Its length is 24 feet, and it is divided so that five of the panels are positive and five are negative. Each machine is

connected to its respective panel, on which are placed an ammeter, automatic cut-out, and double-pole safety fuses, whilst a main ammeter is provided for reading the total output. From the main bus bar, which is capable of carrying 2,000 amperes, are taken 21 circuits, which feed the various parts of the hall. On each pole is fitted a S.P. 200-ampere quick-break switch as well as a 200-ampere fuse, whilst 12 ammeters are provided to read the load on the various circuits. Each "booster" is fitted with a fuse, and by means of a two-way switch either can be used to charge the battery. An eight-way battery switch is also provided for maintaining the pressure on the lighting circuit. In a prominent position are fitted voltmeters for reading the pressure of the dynamos or accumulators. Shunt resistances of the Crompton tubular pattern are used for each machine. The dynamos are all run in parallel with a set of accumulators of such a capacity that in the event of one engine breaking down, they would supply its load till another is switched in. On two separate boards are fitted eight double-pole change-over switches, so that current may be used from the Islington Vestry in the event of an overload. The Vestry have brought in four sets of mains which are taken to a separate switchboard, upon which is fixed four double-pole switches, an ammeter to each service, and a voltmeter. From this board are taken the mains to feed the two change-over switchboards.



Details of Gas Engine.



View of Gas Engines.

The lighting of the hall is carried out by means of arc lamps. These number about 150, and are of the "Crompton-Pochin" 10-ampere type, wired two in series across 100 volts. Those in the centre are suspended from the roof, and raised or lowered by means of counterweights, whilst those under the galleries are raised and lowered by a counterweight with special means for taking up the slack cable. One of the most notable features in the lighting of the Agricultural Hall is the arrangement made to meet the extra demands for current that occasionally arise in the different shows. In order to meet anything beyond the normal demand, temporary plant is frequently employed.

The mains connected to the permanent lighting plant are totally distinct from the mains that are used in conjunction with the temporary lighting plant, and are controlled by the circuit switches in the engine room. Four sets of 200-ampere mains are used for the temporary lighting in the main hall, and at every 24 feet special cut-outs are tapped on for connecting on temporary leads for show lighting. Two sets of 100-ampere mains are run round the gallery for the same purpose. To give an idea as to the number of lights connected on some occasions, it might be mentioned that during the recent Stanley Show the engine room had to give its maximum output (1,900 amperes), whilst a temporary steam plant had to be put down to supply an extra 700 amperes. The temporary plant in this case consisted of three portable type engines of a combined horse-power of 120, driving three dynamos. In addition to the supply from this source, 150 amperes were taken from the Vestry's mains.

Obviously, the running costs of such an installation are of extreme interest, but for private reasons we are unable to give the exact figures, we are assured, however, that they are especially satisfactory when it is remembered that for four months during the year the plant is lying idle.

The consumption of gas per brake horse-power is extremely favourable. On a recent visit to the Agricultural Hall we inspected the log, and found that the average consumption was about 15½ cubic feet per B.H.P.

The following is the record of gas consumption on one of the 25 H.P. nominal Stockport gas engines, running during the Stanley Show at Agricultural Hall :—

							Gas consumed. c. f.
Friday, Nov.	18th,	running from	3	p.m. to	10 25	7 h. 25 m.	5,800
Saturday	„ 19th,	„	3.10	„	10 30	7 h. 20 m.	6,300
Monday	„ 21st,	„	2 30	„	10 30	8 h.	6,800
Tuesday	„ 22nd,	„	3.10	„	10 25	7 h. 15 m.	6,100
Wed.	„ 23rd,	„	2 55	„	10.20	7 h. 25 m.	6,500
Thur.	„ 24th,	„	2 30	„	10.20	7 h. 50 m.	7,000
Friday	„ 25th,	„	3	„	10.10	7 h. 10 m.	6,100
Saturday	„ 26th,	„	2 40	„	10.15	7 h. 35 m.	6,700

The average load for the five engines during the week was 1,480 amperes, at 104 volts (running parallel). The average load of the engine, of which we give the gas consumption above, was about 350 amperes.

The whole of the electrical work has been carried out by Messrs. F. A. Glover & Co., under the supervision of Mr. W. T. Golledge, who also acts as resident engineer for the said firm, the engines being supplied by Messrs. Bilbie, Hobson & Co.

HEATER DETARTARISER.

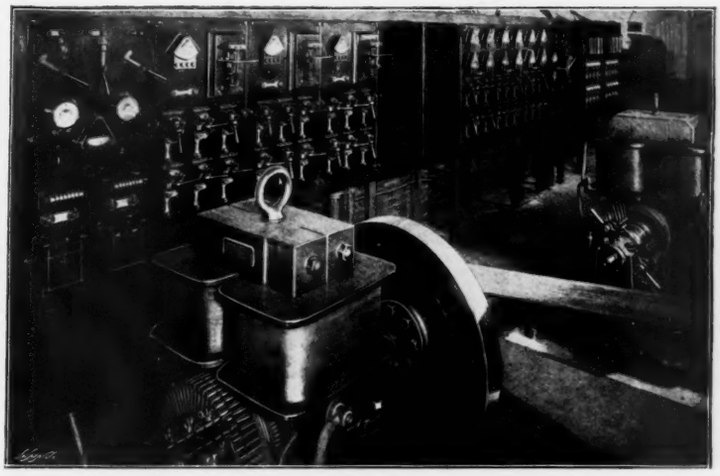
The illustration shows a large "Chevalet" heater detartariser constructed by Mr. William Boby, and which has been for some time in operation at the central station of the Chelsea Electricity Supply Company.

The full capacity of the detartariser is 6,000 gallons of water per hour, which, by its means, is heated to a temperature of 212° F., and at the same time is efficiently softened.

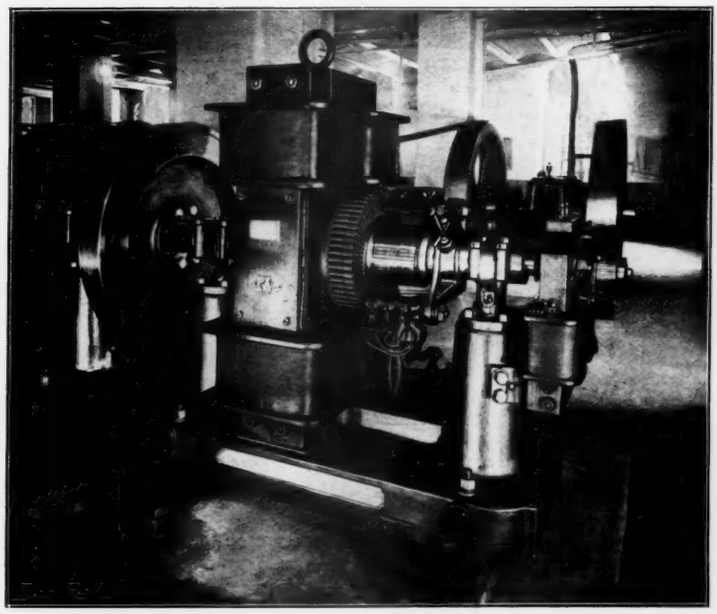
The main exhaust pipe from the engines is shown at the back of the apparatus, a branch being taken from the horizontal portion of the exhaust pipe to the inlet to the detartariser.

The cold water flows in at the top of the machine, by means of the funnel which appears upon the illustration, the flow of water to the machine being regulated by a float contained in the small vessel at the side of the detartariser, the float being connected to a lever actuating a valve fixed to the inside of the funnel.

The softening action of the apparatus depends upon the application of the heat derived from the exhaust steam, to the water, for a period of time sufficiently long to effectually drive off the carbonic acid gas, which renders the contained lime insoluble so that it is deposited upon the inner surfaces of the apparatus itself. It is claimed for this detartariser that by its means the water is kept at actual boiling temperature for a considerable length of time, whilst the back pressure caused in the exhaust pipe is so small as to be practically negligible. Two gauge glasses will be observed in the illustration, and they are so arranged that the amount of back pressure caused can be read upon these two glasses in inches of water column. At full load the back pressure is under ½-lb. above atmospheric pressure. As will be seen the machine consists principally of a number of circular trays set one upon the other, the joints not requiring to be bolted as the weight of the parts, and the water is sufficient to make the joints secure. The bolts shown at intervals round the circumference of the machine are for convenience in putting it together, and during its working these bolts may be loose. For cleaning purposes the whole of the trays can be lifted down and the deposit removed. The deposit takes the form of a compact crust, which, however, does not become hard as there is no direct application of heat to it, and even if allowed to become dry it always remains extremely friable. When wet it is easily removed by a shovel or scraper, and the operation of cleaning is a speedy one. As will be seen by the illustration, the space occupied by the apparatus is not great in comparison to its large capacity. An important advantage of this apparatus is the fact that its heating power does not diminish as the deposit accumulates inside it, and the water is delivered as hot when the proper time for cleaning has been reached as when the apparatus is clean. The heating action is such that the water will have its full heat when the apparatus is working at its greatest capacity; in fact, it has a tendency to be slightly hotter than when the machine is working at lighter loads.



A Large Isolated Plant.—Switchboard.



A Large Isolated Plant.—View of One Set.

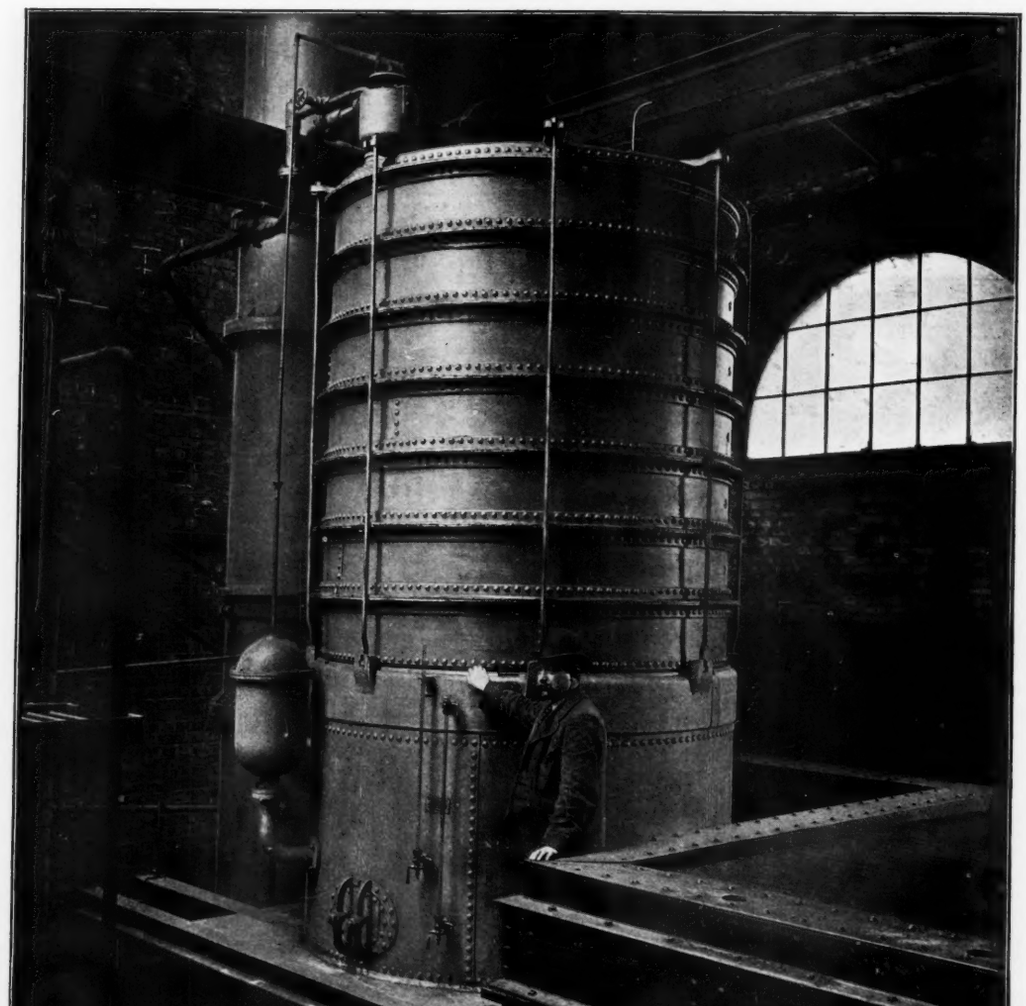
TRAIN LIGHTING.

Although the Midland Railway has spent large sums in establishing oil-gas generating depôts at various points of their system, it would appear that they have not quite abandoned their regard for the electric light. A dining saloon attached to the 6.45 train at St. Pancras has for some time now been lighted by the Stone system. This train travels between London and Manchester, and is one of the company's best trains, equipped for the main part, with the most modern stock.

Quite recently, too, the 5.40 p.m. from St. Pancras to Bradford, *viâ* Nottingham, has also been electrically lighted by the same system, with the exception of a third-class dining carriage, which for the present is lighted by gas. It is, however, understood that Messrs. Stone are fitting another vehicle to take its place, when the entire train composed of six vehicles—all bogies—will be lighted by this system.

We do not know what course is to be pursued in the mode of lighting the coaches yet to be attached to this train, but if the ordinary coaches are to be lighted in the manner those in use are lighted, we question if it will be regarded as a success. The first-class dining carriage is most brilliantly lighted, but this cannot be said of the others. The lighting in all cases is effected from the centre of the vehicle by a form of inverted rigid standard fixed in the roof. In the dining car each of these standards carry four 8-C.P. lights and as each of these clusters serve but two tables, there is an abundance of light. The compartment of an ordinary coach is, however, provided with but two lights—the first-class of 10-C.P. each and the third-class of 8-C.P. each. It is not seen why the private compartment should be less brilliantly lighted than the same space in the dining coach. It would appear that if the 20-C.P. is sufficient for the one it ought to be good enough for the other. It cannot be supposed that a man wants more light to find the way to his mouth, and yet it would seem that such is the idea carried out on many railways. At all events, we fear many will experience some difficulty in determining why one should have so much light in excess of the other.

We have always considered that the centre of the roof is not the best place from which to light a railway coach. As a rule passengers seek the corner seats, and when so seated with a light in the centre of the roof, unless they bend forward so as to get the light upon the subject they may be reading, the light is both deficient and disagreeable to the eyes. The proper position for the light is over the seat occupied by the reader or at his back. Why cannot those who deal with this work give us all the conveniences of which the electric light is capable. It is to be regretted, and we hope to see an improvement in the vehicles which we are told are yet to be lighted.



Heater Detartariser. (See page 867.)

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

(*Continued from page* 864.)

Ipswich.—The Tramways Company has decided to sell its undertaking to the Drake & Gorham Syndicate for £30,000. The undertaking cost £32,000 to lay down and equip, and the present system of horse trams is to make way for electric trolley trams.

Kew and Hounslow.—The London United Tramways Company have commenced laying the electric tramway line through Brentford.

Light Railways.—Applications for light railways are received by the Light Railway Commissioners twice a year, in the months of May and November. The applications received in November, 1898, amounted to 54, under which it is proposed to construct 492½ miles of line, at an estimated cost of £3,344,563. This estimate (says the *Times*) is for construction only, and does not include the cost of plant and rolling stock for their equipment. This is the largest number of applications that has yet been received by the Commissioners in any one half-year. The total number of applications previously received in the four half-years since the appointment of the Light Railway Commission in 1896 amounted to 121 for 1,302¼ miles of line, at an estimated cost of £7,555,976 for construction.

Liverpool.—The Tramways Committee of the City Council was on Wednesday to bring forward a recommendation for the purchase of 12 motor cars, at a cost of £6,752, from the British Thomson-Houston Company, Limited, of London. They also recommended the extension of the electric tram system recently opened.

London.—Writing to the *Daily Graphic* to correct an error, Mr. Clifton Robinson, managing director of the London United Tramways Company, says: "Will you kindly allow me to say that the London County Council have approved of the trolley on the two lines, one from Acton, on the Uxbridge Road, to the Central London Electric Railway, Shepherd's Bush, and the other from the latter point along the Goldhawk Road to Young's Corner, conditionally that we lay down an approved form of underground electric traction on the third section, between Young's Corner and Hammersmith Broadway? The directors of the London United Tramways are now considering the practicability of falling in with the views of the London County Council on this latter point, it being generally conceded that the installation of the underground system is intended as an experiment by the Council at the expense of the company."

Manchester.—Last week a deputation from the Manchester Corporation went to Glasgow to inspect the Springburn electric tramways. After inspecting the line, cars, car works, and power station, luncheon was served at the Municipal Buildings, the Glasgow Tramway Committee and officials being present.

Middleton.—The mayor has received an intimation from the Board of Trade that in a few days that authority will issue an order giving permission to the British Electric Traction Company to construct a tramway between Middleton, Manchester, Rochdale, and Oldham. Application to construct the tramway was made under the Light Railways Act, and the Middleton Corporation entered an opposition on the ground that proceedings should have been taken under the Tramways Act, which offers a purchase clause more equitable for local authorities. However, they have been overruled on that point, and it is expected the tramway will be at once proceeded with. Permission has yet to be obtained to bring the tramway within the boundaries of Oldham, Rochdale, and Manchester, and application in regard to this is being made. Application is being made in sections, plans being last week deposited for the entrance of the tramway upon the boundaries of the city of Manchester at Cheetham Hill.

Rotherham.—At a recent meeting of the Highway Committee a letter was read from the Drake & Gorham Electric Power and Traction (Pioneer) Syndicate, Limited, with reference to establishing an electric traction scheme through Rotherham to Rawmarsh, and asking if the Corporation would sanction their obtaining powers for so doing. The recommendation of the committee was that the town clerk inform them that inasmuch as the Corporation were intending to construct trams they could not entertain their application. The Gas Works Committee have appointed a sub-committee to consider and report as to an installation of electric light for the borough.

Sheffield.—The Corporation tramway power station is being pushed forward. Operations have been in progress since July last. At first there will be three Allis engines of 300 H.P., coupled to dynamos of 225 kw. capacity, and three 300-H.P. boilers by Messrs. J. Brown & Co., Limited.

Sunderland.—A meeting of the ratepayers last week approved the Council's tramways municipalisation, extension, and electrical equipment scheme.

Tynemouth.—A Committee of the Town Council has ratified the proposed agreement between Tynemouth Corporation and the British Electric Traction Company, Limited, which had been tentatively settled. Under the agreement the Corporation are to supply to the company electrical energy for the working of the tramways in the borough and the light railways which the company propose to construct.

TELEGRAPH AND TELEPHONE NOTES.

The City and the Telephone Service.—Last week at the Court of Common Council Mr. Turner, chairman of the Streets Committee, said that the Corporation were about to call a conference in Guildhall of the local authorities of the metropolis on the subject of telephones, and he hoped useful results would be arrived at.

Edinburgh Telephones.—By 29 votes to 19 the Edinburgh Town Council last week disapproved of the minute with regard to a municipal telephone license.

French Cables and War.—The *Times* correspondent at St. John's, Newfoundland, telegraphed on 6th inst: "The French cable steamer, *Amiral Caubet*, is changing the position of the French cables across the Grand Banks to avoid their being cut in war time."

Glasgow Telephones.—At a meeting of the Telephone Committee of Glasgow Corporation on 1st inst. it was intimated that an agreement had been concluded between the National Telephone Company and the Ericsson-Bell Telephone Company, under which no instruments of the Ericsson-Bell type will be sold to the Glasgow or any other Corporation. This is a move of the greatest significance, as the Corporation's tenders and estimates were based on the understanding that Ericsson-Bell instruments, switchboards, and other telephone appliances would be adopted. Writing on November 25th to the town clerk, the Ericsson-Bell Telephone Company said:—"We regret having to withdraw our quotations for multiple switchboards, telephones, &c., dated September 23rd, 1897, for reasons personally explained to you to-day, which please note." Mr. A. R. Bennett, the expert who gave the Corporation an estimate of the cost of inaugurating a municipal system, wrote to Sir James Marwick from Harlesden, London, on the 28th as follows:—"Messrs. L. M. Ericsson & Co., the manufacturers of telephone apparatus at Stockholm, have officially informed me that they have entered into an agreement with the National Telephone Company not to supply any telephone apparatus for Exchange purposes to any municipality or corporation within the British Isles or any licensee of Her Majesty's Postmaster-General, and that any orders must be accompanied by an agreement that the would-be purchaser will not sell, let, lend, or dispose of to, or suffer or permit to be used by, any such municipality, corporation, or licensee. I think that this is a matter that should be brought to the cognisance of the Telephone Committee before any consultation with the National Company takes place. Probably attempts will be made to induce other suppliers to conclude similar agreements."

The Corporation had a lengthy discussion about its proposed Telephone Bill last week. Various clauses were considered and passed. An amendment delaying approval of the Bill until there had been an opportunity to consider the proposals of the National Telephone Company was lost by a majority of 29 votes.

The Parliamentary Bills Committee has agreed to pledge the Corporation Loans Act in substitution of or in addition to the Common Good Fund as security for the carrying out of the telephone scheme.

Government Telegraph in Cuba.—A Chicago paper says that an order has been given to the United States Signal Corps to begin the construction of an overland telegraph line from Guantanamo, *vid* Santiago de Cuba to Manzanillo. The line is to be constructed for the transmission of official despatches by the Government, but it is announced that commercial telegrams will be accepted.

Hampstead Telephones.—Last week the General Purposes Committee recommended the Vestry to take no further action at present in the matter of the agreement proposed to be entered into with the National Telephone Company on the subject of underground mains.

Islington Telephones.—A long debate on the overhead telephone wire question had been expected at the last meeting of the Islington Vestry consequent upon the presentation by the Works Committee of a report stating that the National Telephone Company had taken no steps to comply with repeated communications requesting the company to conform to the bye-laws of the London County Council made under the London Overhead Wires Act, 1891. The committee further stated that so far from complying with such notices the company had continued to ignore the bye-laws and to erect overhead wires of a span exceeding 115 yards, and they recommended that instructions should be given for proceedings to be at once taken against the company in the matter. Before this report was reached, Mr. W. F. Dewey, the vestry clerk, announced that a memorial on the subject had been received from the National Telephone Company, together with a number of letters from subscribers in the parish protesting against the proposed action of the Vestry. The vestry clerk intimated that Mr. Clay, the company's district superintendent, desired to lay their case before the Vestry, and the chairman of the Works Committee then obtained permission to withdraw the report for further consideration. After a long debate, the Vestry decided that the matter should not be shelved but should be further considered.

Reduction of Telegraph Rates to the Cape.—We make the following extract from a letter addressed by Mr. Henniker Heaton to the Associated Chambers of Commerce of South Africa. After referring to the postal rates, Mr. Henniker Heaton writes:—"There can be no doubt that the cable is far too costly to be generally used. A beneficent invention, which should enure to the good

of all, is a luxury for the few. It would give me the greatest gratification if there were electrical communication, at popular rates, with colonies like South Africa. A rate of 5s. per word is in effect a crushing tax on commerce. Thanks to the energy of Mr. Rhodes, we shall soon have a landline from Capetown to Alexandria. Let us hope that the great man will insist on the lowest tariff that will suffice to pay expenses, and yield a moderate profit. In my opinion messages might be sent at a profit from London, or, say, Canterbury, to Capetown, at 1s. per word. (In Australia a message can be sent 3,000 miles overland for 1d. per word.) I need not enlarge to men of business on the priceless advantages of cheap electrical transmission. It is as wrong and foolish to tax letters and telegrams in order to enrich a handful of capitalists, as it is to erect tollgates on a bridge, or on the highway, for the benefit of the lord of the manor. Yet we have these heavy cable rates to pay to every part of the Empire, and I care not who knows it, I am a determined enemy of such rates. I would earnestly beg your association to take a leading part in promoting the acquisition of all cables by the State, all over the Empire, with a view to reducing and popularising the tariffs. Failing this, force our traffic over English and Continental Government landlines."

Strategic Cables.—We read that the House of Assembly of the Cape of Good Hope has passed, without debate, the Naval Contribution Bill, by which the Cape agrees to contribute annually the sum of £30,000 for the purposes of the Admiralty. It may be remembered that it was at one time suggested that this contribution should be diverted from this purpose, and should be handed over to the Eastern and allied Telegraph Companies to assist them in carrying their "all-British" cable *vid* the Cape to Australia; a work which these companies may reasonably be invited to carry out without any increase to the very liberal subsidies which they already receive. In discussing the contribution made by the Cape, the *Toronto Globe* expresses the opinion that, as far as Canada is concerned, it would be preferable to contribute to the laying of a strategic Imperial cable across the Pacific. The following is a telegram from the Ottawa correspondent of the *Outlook*:—"I have the authority of a member of the Dominion Government for the statement that Canada is prepared to reconsider her position on the question of the all-British Pacific cable. As the negotiations now stand, Australasia would contribute four-ninths of the cost, the Motherland three-ninths, and Canada two-ninths. I am now able to state that Canada, though realising the preponderance of British and Australasian interest in the project, is prepared, if necessary, in view of its Imperial importance, to increase her share beyond two-ninths. An early announcement of the amended proposition is expected. Lord Strathcona, High Commissioner in England, who is in conference with Sir Wilfrid Laurier and Sir Richard Cartwright at Washington, favours a speedy conclusion to the negotiations now proceeding with the Home Government. The matter becomes urgent because of the acquisition of the Philippines by the United States and the probable construction of a cable to San Francisco, thus forestalling the Imperial project." It would appear as if the French Government recognise the strategic value of submarine cables, as we read that the French cable steamer *Amiral Caubet* is at present changing the position of the French cables across the Banks of Newfoundland, to avoid the risk of their being cut in war time. We may here add that the New York-Hayti cable, which at one time was looked on as a "strategic" prolongation of the French Atlantic cables, has been interrupted since the end of last month.

Submarine Cables.—A Reuter telegram from the Hague says that on 29th ult., the Second Chamber of the States-General in its sitting approved the convention between Holland and Great Britain concerning joint property in submarine cables between the two countries.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
West Indies—		
St. Lucia-St. Vincent ...	Sept. 24th, 1898 ...	...
Amazon Company's cable—		
Cable beyond Gurupa ...	June 8th, 1898 ...	...
Saint Louis-Novonha ...	Oct. 17th, 1898 ...	...
Para-Maranham	Nov. 25th, 1898 ...	...
Dartmouth-Guernsey ...	Dec. 1st, 1898 ...	...
New York-Hayti	Oct. 30th, 1898 ...	...
Landlines.		
Majunga-Tananarive ...	Nov. 22nd, 1898 ...	Nov. 30th, 1898.
" " ...	Dec. 6th, 1898 ...	...

Telegraph Rates to the Argentine Republic.—In his message to Congress, the President of the United States says:—"I have found occasion to approach Argentina with a view to the removal of the differences in the charges imposed upon cables of the American Corporation in the transmission between Buenos Ayres and the cities of Uruguay and Brazil of through messages from and to the United States. Although the matter is complicated by the exclusivist concessions granted by Uruguay and Brazil to foreign companies, I have strong hope of a good understanding being reached." In conclusion, President McKinley expresses his sense of the fitness of an international agreement whereby the interchange of messages over connecting cables may be regulated on a fair basis of uniformity.

CONTRACTS OPEN AND CLOSED.

OPEN.

Barnsley.—December 12th. The Corporation is inviting tenders for the supply and erection of (1) Lancashire boilers and Green's economiser; (2) engines, dynamos, switchboard, condensers, feed-water pumps, balancing transformers, boosters, piping, tanks, crane, wiring of electricity supply works, and engine, &c., foundations; (3) secondary batteries and accessories; (4) feeder and distributing mains (solid system), potential leads, network and service boxes, and service connections. Specifications and all particulars can be obtained on application to Mr. Thos. L. Miller, M.I.E.E., 7, Tower Buildings, N., Water Street, Liverpool, on payment of £1 1s. for each section, returnable as usual.

Beckenham.—December 17th. The Urban District Council invites tenders for water-tube boilers, alternators, transformers, pipe work, feed pumps, arc lamps and posts, cables and other street works, travelling crane, &c., &c., for the electric lighting scheme. Specifications, &c., from Messrs. Wilson & Story, 66, Victoria Street. See our "Official Notices" November 18th.

Fleetwood.—The North Euston Estate Company, Limited, wants tenders for an installation of wiring, switchboards, &c., for the electric light, current being taken from the town supply; also for electric bells. See our "Official Notices" December 2nd for particulars.

Leeds.—December 29th. The Council is inviting tenders for underground conductors, switchboards, &c., in connection with the electric tramways. Particulars from the city engineer or Messrs. Hopkinson & Talbot, 26, Victoria Street, S.W. See our "Official Notices" for particulars.

Salford.—December 15th. The Electric Lighting Committee want tenders for the supply and erection of the following plant for the Electric Light Committee. Section (1) boilers; (2) engines; (3) dynamos; (4) boiler feed pumps, &c.; (5) mechanical stokers; (6) superheaters; (7) economisers; (8) condensers, &c.; (9) steam and water pipes; (10) cranes and weighing machines; (11) tanks, &c.; (12) switchboards; (13) booster. Specification, information, &c., may be obtained from the electrical engineer, Walness Road, Broughton, on payment of £5, returnable as usual.

Shoreditch.—December 13th. The Vestry want tenders for six direct-current rotary transformers. See our "Official Notices" November 25th.

Stirling.—January 2nd. The Burgh Commissioners are inviting tenders for Lancashire boilers, engines, dynamos, pumps, piping, crane, accumulators, switchboard and boosters, arc lamps, and various other apparatus, &c., for the electric lighting of the town. Consulting engineer, Prof. A. B. W. Kennedy. See our "Official Notices" this week for particulars.

Sunderland.—December 30th. The Corporation wants tenders for the supply of three 125-kw. direct current high speed steam dynamos, 460 volts. Borough electrical engineer, Mr. J. F. C. Snell. See our "Official Notices" for particulars.

CLOSED.

Hampstead.—At the last Vestry meeting, on the recommendation of the Lighting Committee, it was agreed to accept the estimates of the following firms for the supply of plant in connection with the West End Lane and Mill Lane arc lighting scheme:—For arc lamps and switches, Messrs Crompton & Co.; alternating lamps and switches, the Reason Manufacturing Co., Limited; arc lamp posts, Mr. J. Kershaw; street boxes and cast-iron pipes, Messrs. Reid Bros.; and arc lighting cable, rubber insulation, Messrs. W. T. Glover & Co.

Shoreditch.—The Vestry on Tuesday resolved to accept the quotation of the British Insulated Wire Company to supply and lay conduits in the Haggerston District at a cost of 10s. 8d. per yard.

FORTHCOMING EVENTS.

Monday, December 12th.—At 8 p.m. Society of Arts. "Acetylene," by Prof. Vivian B. Lewes. Four lectures. Cantor Lecture IV.—The combustion of acetylene; acetylene burners; smoking and carbonising of burners; burners for heating; acetylene for gas engines; diluted acetylene and its applications.

Wednesday, December 14th.—At 7.30 p.m. The Institution of Electrical Engineers (Students' Section), in the Library of the Institution. Paper on "Notes on Electric Light Installations," by F. W. Purse, Student.

DINNER OF THE INSTITUTION OF ELECTRICAL ENGINEERS.

The tenth annual dinner of the Institution was held at the Hotel Cecil on Wednesday evening, Mr. J. Wilson Swan, the President, in the chair. Among the guests were the Right Hon. the Earl of Dundonald, the Right Hon. the Earl of Lichfield, the Right Hon. Lord Monkswell, the Right Hon. G. Shaw-Lefevre, Sir Richard Webster, Q.C., General Sir R. Harrison, Mr. W. H. Preece, C.B., Admiral Sir W. J. L. Wharton, Sir J. Crichton Brown, F.R.S, Sir Courtenay Boyle, and Sir E. Frankland.

After the usual loyal toasts had been duly honoured, Sir Richard Webster rose to propose the toast of the evening, the "Institution of Electrical Engineers." He said this year had robbed the Institution of two great lights, Latimer Clark and Dr. John Hopkinson. He looked upon the Institution as the embodiment of the most extraordinary development of science of the Victorian era. It was true to say that the developments of electricity were practically taking place during the 60 years of Her Majesty's reign. He referred to the pioneers of land and submarine telegraphy, men who were discoverers in an unexplored and trackless forest who had cleared away enormous difficulties. The present electrical engineer he considered the most powerful factor in modern scientific work. In coupling one name with the toast, he held that no man could more worthily represent the Institution than Mr. J. Wilson Swan. He (the speaker) had been associated with Mr. Swan, and had learned to appreciate the marvellous acumen he brought to bear upon his discoveries.

The President, in responding, said if electrical engineering was not an ancient art, he thought it was a little older than the statement of Sir Richard Webster implied. That was impressed on his mind by the rhyme which he learned from an old sailor 60 years ago:—

> With spark that he caught from the skies
> He displayed the unparalleled wonder,
> And saw with delight and surprise
> That a rod could protect us from thunder.

Electrical engineering then referred to was of a negative kind, preventing it from doing mischief. The difference between the time of Franklin and our day was that, instead of merely preventing it from doing mischief, electricity of Victorian times had been brought into subjection, and had been made a useful, obedient, and profitable servant. The Institution had been founded when the first great application of electricity was undertaken—telegraphy. It had, however, adapted itself to the wants of the times, and kept in the van of progress. It had twice changed its name, and twice modified its rules. They could congratulate themselves upon its present position; its revenue was increasing, their finances were sound, and they made both ends meet. In course of time there would be a local habitation which they could call their own. Referring to the statistical side of electricity, they could count their tramways by thousands of miles, their horse-power by hundreds of thousands, and their incandescent lamps by tens of millions. In concluding, the president made touching reference to the deaths of Mr. Latimer Clark and Dr. John Hopkinson.

Rear-Admiral Sir W. J. L. Wharton, in responding for the Navy, said the service with which he was associated occupied a very different position to-day to that of some years ago. Electricity might claim a considerable share in that improvement, for electricity was no more at home than on board ship. General Sir Richard Harrison, on behalf of the Army, referred to the Army Telegraph Corps, which he described as the finest in the world; it went all over the world, and did its duties well. They in the Army were obliged to the Institution for organising its electrical corps, and wished it success. Mr. R. E. Crompton, commanding officer of the Electrical Engineers Volunteers, said that a great duty developed upon the corps in carrying out the work of their late commanding officer. He would not have the slightest difficulty in filling up the ranks to-morrow, but they must fill them with the right men.

Sir James Crichton Brown, in proposing the toast of "Science," said that electrical engineers were not infected with pessimism. They had conferred great benefits upon humanity, and would no doubt do more; he coupled Mr. Preece's name with the toast, who had done much to promote human intercourse, and also that of Prof. Ramsay. Mr. Preece, in responding, said that the greatest civiliser was the engineer, first by the telegraph and then the railway. Prof. Ramsay, in responding, pointed out the importance of research and teaching going hand in hand.

Major-General Webber, in submitting the toast of the "Guests," referred to the number of industries with which the Institution was in touch. The Hon. G. J. Shaw-Lefevre and the Hon. W. P. Reeves briefly responded, and some time afterwards the proceedings terminated.

NOTES.

More Tesla Marvels.—The *New York Herald* of November 13th contains a sensational article on Tesla's recent inventions in wireless transmission of power. The article is full of inaccuracies evolved from the unscientific imagination of the reporter. Here are some of the gems:—Speaking of Tesla's new generator, it is said: "With a machine creating a pressure of millions of volts, Tesla lashes the vast ocean of electricity of the earth into a cyclonic storm. Instantly the waves spread in all directions through the universe of matter." By this we are led to believe that Tesla transmits power by means of electric waves. This may, as a matter of fact, be true, but, nevertheless, Tesla expressly repudiates this mode of transmission in his specification. A description, with an illustration, is given of Tesla's new torpedo boat, which, however, appears to be merely controlled from the shore by Tesla currents. The motive power is an old-fashioned battery of accumulators on board. Moreover, the controlling is not done by the new Tesla currents, but by a species of Marconi telegraphy. At least, there is a coherer on board the boat, and this is affected by electric waves sent by an oscillator "which may be tucked away in one's pocket like a cigarette case." Since the generator of Tesla's high pressure air-piercing currents contains 50 miles of wires, it is not very suitable for carrying in the pocket. On turning a little crank, the generator gives forth two waves at each half-turn. "The effect of these is like that of the vibrations produced by the voice in a telephone. On the vessel to be controlled is a broken electric circuit, loose metallic particles of a metallic oxide being at the point of separation." By means of the coherer, which is evidently what the reporter is describing, electric circuits are closed on board the torpedo boat, which control the rudder and the battery which furnishes the motive power. We imagine Tesla is not the first to propose the application of electric wave telegraphy to control the movements of an electric torpedo boat.

Lighting by Atmospheric Electricity.—Mr. W. A. Eddy, of Bayonne, N.J., according to the *New York World* of November 20th, professes his ability to light New York by atmospheric electricity. His *modus operandi*, as far as we can make it out from the somewhat vague and sensational account published by our contemporary, is to suspend a collector, consisting of a sheet of tinfoil, by means of kites, at a considerable height in the air. In one experiment described the height was 1,800 feet. A thin copper wire looped to the kite cable brings the current to the interior coating of a Leyden jar, between which and the outer coating a stream of sparks pass, which forms the source of light. A rod of carbon may be used to intensify the effect. Mr. Eddy has found that the height to which he has to send his collector, in order to get the necessary discharge, depends greatly on the humidity of the atmosphere as measured by the wet and dry thermometers at the surface of the ground; the drier the air, the higher must the collector be suspended. Very thin copper wire (·080) was used, and even less than this size can be employed. Mr. Eddy found that India-rubber gloves were not a protection against the high tension sparks drawn from the clouds, and experimenters would do well to remember the fatal results of some of the early experiments in this direction. Mr. Eddy found that the safest plan was to wind his kite cable on a barrel of dry wood. But why not adopt the easier method of employing eddy currents.

The Copper Market.—With reference to our note of a fortnight ago upon the rapid advance in the price of refined copper (see Electrical Review, November 21st), the last statement of Messrs. R. H. Merton and Co. shows that the price is still rising, the increase for the 15 days ending November 30th last having been equal to 7s. 6d. per ton. The prices of G.M.B.'s at the latter date was £56 2s. 6d. per ton, as compared with £43 2s. 6d. on November 30th, 1895, and £48 only 12 months ago. The rise has, however, had the effect we predicted in our last note of increasing the shipments from foreign countries to Europe, and the stock of copper in English and French ports, and afloat thereto, has increased by 987 tons during the last 15 days, the total now being 26,897 tons. For the month ending November 30th the total supplies were 20,340 tons, and the total deliveries 19,241 tons; while for the 11 months of this year the total supplies have been 208,253 tons, as against 213,311 tons delivered. The figures for the corresponding 11 months of 1897 were 203,332 tons and 205,168 tons respectively, so that the increase in the consumption of copper in Europe in 1898 has not been so marked as one would have expected from the active demand. Cable manufacturers and others using large amounts of copper for electrical purposes will require to watch the market carefully before covering their requirements for the coming year. Our own impression is that the present high prices of copper will not be maintained during 1899.

Bearing Stresses.—During a recent discussion of the Engineers' Club of Philadelphia, one of the speakers suggested an idea for calculating bearings. Apart from differences of materials and continuity, and constancy or otherwise of the motion and pressure, which conditions could probably be met by a coefficient, there remains the weight per unit area and the speed of rubbing. It is suggested that the unit pressure in pounds and the velocity should be multiplied to give a product somewhat confusingly termed "foot-pounds." But this product varies so much when taken from different satisfactory bearings, that it is clear both factors must not come into the equation on even terms. Speed may increase but does not demand an equal proportionate decrease of pressure. Thus main shafts may be given a maximum product of 50,000, but crank pins may go as high as 200,000, which is due to greater movement and less constant pressure. Such a rule might be worked out that would be useful as a guide, though it could not be made rigid. It can never be known under what conditions a machine may have to work, so that there can be no fixed rule. In many cases a maker must provide for where his experience tells him conditions are unusually bad.

A Steam Boiler Furnace.—Mr. William Kent, of Passau, New Jersey, has designed a furnace particularly for steam boilers of the water-tube type, which use bituminous coal or other fuel containing a large quantity of tarry or gaseous matter, and which in burning distils a large amount of combustible gases. *Trade and Industry* says that in the operation of this furnace with ordinary grates and with bituminous coal or other gaseous fuel the alternate method of feeding coal is preferred—that is, the fresh coal is spread alternately on the right and left sides of the grate, an interval of some minutes of time elapsing between the feeding on the right and on the left sides. Immediately after fresh coal is put on one side of the furnace dense smoky gases arise from it, which in the usual boiler-setting would pass out of the chimney unburned, since in the ordinary setting there is no means provided for mixing with them an abundant supply of highly heated air; but in this furnace such air is supplied through the bed of partially burned and very hot coal and coke on the other side of the grate. When automatic or mechanical stokers are used of the type which causes the coal to gradually move from the front of the furnace to the rear, dense smoky gas arises from the front portion and clear hot gas with an excess of air from the rear portion. In the ordinary setting of a water-tube boiler when such stokers are used, the two currents, one of smoky and the other of clear gas, pass directly upward into the gas passage through the tubes and do not become mixed until they have been cooled by the heating surfaces of the boiler below the temperature of ignition.

Galvanometers and Magnetic Dip.—Mr. A. P. Trotter, the Cape Government electrician, writing to *Nature* from Cape Town on November 9th, says that while the variation of magnetic dip in Europe (from about 71° in Aberdeen to 58° in Rome) probably gives little, if any, trouble to users of compasses and portable horizontal galvanometers with pivoted needles, the dip of about 58° *to the south* at the Cape is sufficient to disturb seriously such instruments. "I have seen several galvanometers which were useless until re-adjusted; these, having been sent out by makers of high reputation, were thought to have received damage on the voyage. I learn that it is a matter of routine in the Post Office to correct all new instruments for dip. Small pocket compasses are not appreciably affected, because the centre of gravity of the needle is generally well below the point of support, and prismatic compasses escape, probably, on account of the weight of the card. Instrument makers could easily arrange a small magnetic field in their testing rooms, with a dip to the south of about 60°, in which to adjust instruments intended for the Cape or Australia."

An Improved Dynamo for Three-Wire Circuits.—Up to a few years ago the three-wire system was employed in all large isolated plants and small low tension stations by reason of the large saving in copper over the two-wire system. It was found, however, says the *Electrical World*, that where the all-day load was less than the capacity of two of the standard units employed, the losses in operating the small or lightly loaded machines offset the saving in copper at full load. Therefore, in most plants recently installed the simple two-wire system has been adopted, and many small stations are now using this system with 250-volt lamps, although the higher price of such lamps and their lower efficiency largely offsets the saving in copper. Several methods have been devised for supplying a three-wire system from a single machine, with small motor-generators to balance the system, a few machines having been built with double armature windings and two commutators. All of these methods, however, have been more or less complicated, and none will operate when the system is considerably out of balance. There has lately been placed on the market a machine that, it is claimed, will supply a three-wire system and maintain the voltage with any distribution of load. It is of the usual multipolar construction, with single armature winding, single commutator, &c. It differs from ordinary machines only in the manner of exciting the fields, which is a modification of the multi-circuit system developed by Mr. Rushmore in his multi-voltage dynamos, motor dynamos and multi-circuit arc machine. There is now running at the Rushmore works, in Jersey City, a 30-kw. machine supplying a three-wire system that fulfils all the conditions of two 110-volt machines in series. It will deliver its entire output at 220 volts, or at 110 volts, and one side may be loaded to 75 per cent. of the total kilowatt capacity of the machine without loss in efficiency and without interference with the other side, which may or may not be loaded. The brushes are fixed, and there is no sparking with any distribution of load. One side of the system may be kept constant at any voltage, and the other raised or lowered to any extent without the least interference.

Forthcoming Action.—We understand that there will shortly be heard in the Law Courts an action which has been brought by Mr. G. E. Heyl Dia against Messrs. W. T. Glover & Co., Limited. Mr. Heyl Dia seeks to recover damages for alleged wrongful determination of an agreement whereby he was employed as superintendent engineer of the company for a period of five years, and makes other claims with reference to his invention of the insulating material known as Diatrine, the sole right to which is claimed by the company.

Presentation.—On Friday last, Mr. A. T. Cummins was the recipient of a handsome "Tantalus Liqueur Cabinet" on the occasion of his resigning the position of chief assistant engineer at the Leyton electricity works. The presentation was made at the works by Mr. H. C. Bishop, chief engineer, on behalf of the engineers and staff.

Influence of X Rays on the Luminosity of Gases.—When a tube containing gas, at low pressure, is exposed to electrical oscillations, it becomes luminous when the pressure is reduced sufficiently, but if exposed also to the influence of X rays the pressure at which luminosity occurs is increased. This effect of the rays was recently examined quantitatively, and the sub-joined table gives the pressure at which the gas becomes luminous—(I.) by the oscillations alone; (II.) by the simultaneous action of X rays; (III.) gives the percentage increase:—

Molecular weight.		I.	II.	III.
Hydrogen	2	71 mm.	94 mm.	32·4
Oxygen	32	51 „	68 „	33·3
Methylic alcohol	32	17·5 „	27·5 „	57·1
Ethylic alcohol	46	16·5 „	26 „	57·5
Ethylic ether	74	14 „	24 „	64·3
Chloroform	119	10 „	18 „	80·0

The influence of the X rays increases with the molecular weight and molecular complexity of the gas. Alexander de Hemptinne, writing in the *Zeitschrift für Physikalische Chemie*, 1898, No. 26, p. 165, says that he does not consider the effect to be due to decomposition into atoms, or ions, and advances, with reserve, the hypothesis that a certain mobility is imparted to the ether by the rays, and this causes acceleration of the intramolecular oscillations, and hence, under the influence of the electrical oscillations, causes dissociation of some molecules, and brings about a multitude of minute discharges from molecule to molecule. As the luminous gas in a vacuum tube has conducting properties, the author considers it possible that it also, like metals, would absorb the X rays, but experiments show that this was not the case, the luminous tube being as transparent in this respect as a non-luminous tube.

Northampton Institute.—To-night from 7 to 11 p.m. the first annual members' and students' conversazione and exhibition will be held at the above institute. There will be various lecturettes in the course of the evening, including one by Dr. Mullineux Walmsley on "Wireless Telegraphy." There will be telephones connected to the theatres, swimming and other displays, and a programme of musical selections will be performed by Madame Sophie Davies' mandoline band. Exhibitions in the various laboratories and workshops will also form part of the proceedings.

Lectures.—A course of free lectures on "Magnetism and Electricity at Rest," fully illustrated with experiments, is now being given every Thursday evening, at 8 p.m., by Mr. J. W. Waghorn, D.Sc. (London), in the Society of Friends' Mission Hall, Roscoe Street, Bunhill Row, E.C. These lectures are promoted by the St. Luke's parochial charities, in conjunction with the London Society for the Extension of University Teaching.

Electrolytic Effects at Dayton.—New York *Electricity* states that a curious state of things was observed in investigating the electrolysis of water-pipes in Dayton, O.; it was found that stones and pebbles near the pipes in some cases seem to have been electroplated with the metal of the pipe, a circumstance which one of the experts believes has never been observed before.

The Royal Society.—Among the papers down for reading yesterday afternoon was one by Mr. S. R. Roget on "Effects of Prolonged Heating on the Magnetic Properties of Iron."

Appointment.—Mr. Thomas Mackenzie, district manager of the National Telephone Company at Inverness, has been appointed manager of the Mid-Lanark district, with his headquarters at Hamilton. He will be succeeded in Inverness by Mr. Rodger, district manager, Banff.

Blackpool Tramways.—It is stated that the Blackpool Council has stopped work on the conversion of the conduit tram system to the overhead trolley until the General Purposes Committee has been able to go further into alternative methods. The Council is influenced by the financial success of the conduit at New York.

The Waterloo and City Again.—It is stated that last Monday morning another breakdown occurred on the Waterloo and City Railway, with the result that for some time only one line of metals could be used.

Appointment Vacant.—The Hull Electric Lighting Committee wants a mains superintendent at £120 per annum. See our "Official Notices."

Portraiture.—Our contemporary, the *Machinery Market*, every month makes a strong feature of the personal element, and gives a separate sheet photograph of the subject of its opening article. The December issue gives the place of honour to Mr. W. H. Patchell, A.M.I.C.E., &c., the engineer-in-chief to the Charing Cross and Strand Electricity Supply Company.

Scholarships.—The following is a list of scholarships awarded in connection with the present Session, 1898-99, of the Central Technical College, Exhibition Road:—Clothworkers' Scholarship, £60 a year, to A. J. Cook; Mitchell Scholarship, £50 a year, to R. H. Collins; John Samuel Scholarship, £30 and free education, to F. C. Hounsfield; Institute's Free Studentships to R. H. Buckie, A. W. Harrold, and W. H. P. Brounger.

Personal.—We understand that the technical editorship of the *Trade Unionist* is being taken over by Mr. W. G. Bond.

NEW COMPANIES REGISTERED.

Doulton & Co., Limited (59,713).—This company was registered on November 29th, with a capital of £750,000 in £1 share (350,000 £5 per cent. cumulated preference), to acquire the business carried on as "Doulton & Co." at Lambeth, Rowley Regis, Burslem, St. Helens, Smethwick, Paisley, Paris, Liverpool, Manchester, Birmingham and Glasgow, to adopt an agreement with H. L. Doulton, and to manufacture, sell, and deal in Doulton ware, Lambeth-faience, plain and art stoneware, earthenware, china, fire-clay, bricks, tiles, electrical and art pottery, glass, &c. The first subscribers (each with one share) are:—H. L. Doulton, and R. D. Doulton, High Street, Lambeth, potters; B. Hannen, 4, Pembridge Place, W., gentleman; W. A. Turnbull, J.P., Oaklands, Hildenborough, Tonbridge; Mrs. J. M. Doulton, Bowling Green House, Putney Heath; Mrs. S. L. Hooper, The Knoll, Putney; Miss K. D. Doulton, 38, Hyde Park Gate, S.W. The first directors (to number not less than three nor more than seven) are Henry L. Doulton, Ronald D. Doulton, Benjamin Hannen and Wm. A. Turnbull; qualification, £100; remuneration, £400 each per annum, with £500 for the chairman.

Electric Automobile Syndicate, Limited (59,714).—This company was registered on November 29th, with a capital of £900 in £10 shares, to acquire, own, and work certain patents and rights, and to manufacture, sell, and deal in electric vehicles, motors, machinery, &c. The first subscribers (each with one share) are:—Herbert E. Cohen, 2 and 8, John Bright Street, Birmingham, India-rubber manufacturer; Harry Richardson, St. Ermins, Westminster, director; Albert Brown and Frederic Brown, 28 to 30, Great Eastern Street, E.C., merchants; Edward A. Cohen, 172, Sutherland Avenue, Maida Vale, W., merchant; J. S. Blanckensee, 68, Priory Road, N.W., gentleman; Joseph B. Simmons, 7, Taviton Street, Gordon Square, W.C., costumier. Registered without articles of association. Registered office, 1, St. Swithin's Lane, E.C.

Hiram S. Maxim Electrical Corporation, Limited (59,728).—This company was registered on November 30th, with a capital of £250,000 in £1 shares, to adopt an agreement with the Hiram S Maxim Electric Lighting and Engineering (Pioneer) Syndicate, Limited, to acquire an invention as applied to electric lighting by H. S. Maxim, and to carry on the business of electricians, electrical engineers, electrical apparatus manufacturers, suppliers of electricity, &c. The first subscribers (each with one share) are:—M. E. Williams and G. Neville, Winchester House, E.C., solicitors; J. de Meray, 1, Rutland Gate, Hyde Park, gentleman; M. Devenish, 7, Cavendish Place, W., gentleman; G. Terrell, 8, Copthall Court, E.C., solicitor; F. A. English, Addington Park, Surrey, gentleman; A. H. English, Warnford Court, E.C., gentleman. The first directors (to number not less than two nor more than seven) are to be nominated by the subscribers; qualification, £500; remuneration, £250 each per annum, and £500 for the chairman.

Telephone Construction Company, Limited (59,742).—This company was registered on December 1st, with a capital of £20,000 in £1 shares, to enter into an agreement, dated November 28th, between George Hooper, of the one part, and David O. Roberts (on behalf of the company) of the other part, to establish, work, manage, control, and regulate telephone exchanges and electric light works, and to carry on the business of a telephone, telegraph and electric light, heat and power supply company. The first subscribers (each with one share) are:—Louis Schramm, Evelyn, Belgrade,

Hampton-on-Thames, electrical engineer; William G. H. Monypenny, Hadlow, Tonbridge, gentleman; Robert Curzon, 14, Grafton Street, W., gentleman; George Hooper, 21, Lincoln Road, East Finchley, gentleman; James H. Steinhardt, 23, Paget Road, Stamford Hill, agent; James A. Brymer, 20, Maclise Road, Kensington, W., merchant; and James Phillips, 148, Great Dover Street, S.E., clerk. The first directors (to number not less than four nor more than seven) are to be nominated by the subscribers; qualification, £100; remuneration as the company may decide. Registered office, 17, Gracechurch Street, E.C.

S. M. Van Hinden Electrical Company, Limited (59,746).—This company was registered on December 2nd, with a capital of £1,000 in £1 shares, to enter into an agreement with Solomon J. Van Hinden, and to carry on at Liverpool and elsewhere the business of electrical and mechanical engineers, electricians, electrical apparatus manufacturers, suppliers of electricity, merchants, concessionaires, patentees, financial agents, &c. The first subscribers (each with one share) are:—Alfred J. Vickary, 46, Lidderdale Road, Liverpool, merchant; Solomon M. Van Hinden, 3, Lord Street, Liverpool, agent; John Beynon, 34, Devonshire Road, Forest Hill, S.E., book-keeper; Miss Gertrude Vickary, 50, Alderson Road, Liverpool; Isaac Gorfunkle, 50, Stanley Road, Bootle, furnisher; Wolfe Gorfunkle, 209, Great Homer Street, Liverpool, furnisher; and Mrs. Elizabeth Vickary, 46, Lidderdale Road, Liverpool. The first directors (to number not less than two nor more than five) are Alfred J. Vickary and Solomon M. Van Hinden; qualification, £100; remuneration, £100 each per annum.

British Schuckert Electrical Company, Limited (59,762).—This company was registered on December 3rd, with a capital of £200,000 in £10 shares, to carry on in Great Britain, her Colonies, and dependencies the business of electrical and general engineers, suppliers of electricity, electrical contractors, electrical apparatus manufacturers, mechanicians, cable and wire manufacturers, copper smelters, &c. The first subscribers (each with one share) are:—H. Alderson, 6, Hyde Park Street, W, major-general; P. A. Macmahon, 12, Shaftesbury Avenue, W., major (retired); F. Manuelle, 57, Gracechurch Street, E.C., merchant; E. Kraftmeier, 54, Parliament Street, S.W., managing director of a company; F. T. Eggers, 11, Portland Place, W., gentleman; H. E. Golding, 99, Cannon Street, E.C., solicitor; H. J. C. Wells, 14, Minster Road, West Hampstead, clerk. The number of the directors is not to be less than three nor more than eleven. The first are Major-General Sir Henry Alderson, A. Hassler, Percy A. Macmahon, Edward Kraftmeier, Frederic Manuelle, and F. T. Eggers (managing director); qualification, £200; remuneration, 1¼ per cent. each on all profits, after the payment of a 4 per cent. dividend on the ordinary shares.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Alderley Edge and Wilmslow Electric Supply, Limited (47,663).—This company's return for 1897 was filed on September 28th. The capital is £30,000 in £1 shares; 7 shares have been taken up, and 2s. 6d. per share has been called, 7s. 6d. has been paid, and 10s. is in arrears.

Monte Video Telephone Company, Limited (27,208).—This company's annual return was filed on November 14th. The capital is £160,000 in £1 shares (87,000 preference); 84,000 preference and 71,000 ordinary shares have been taken up and are considered as fully paid.

Harry W. Cox, Limited (57,703).—This company's statutory return was filed on October 18th, when 1,505 shares were taken up out of a capital of £2,000 in £1 shares. Three shares have 2s. 6d. per share considered as paid, and £1 per share has been called and paid on 1,502 shares.

Wireless Telegraph and Signal Company, Limited (53,403).—This company's annual return was filed on October 28th, when the capital of £100,000 in £1 shares was fully taken up; 60,000 shares are considered as paid, and £40,000 has been paid on the others. The capital has since been raised to £200,000.

Venezuela Telephone and Electrical Appliances Company, Limited (31,305).—This company's annual return was filed on November 19th. The capital is £85,000 in 70,000 shares of £1 each, and 1,500 shares of £10 each. All the former and 860 of the latter have been taken up, and 56,506 £1 shares are considered as paid. The full amount has been called on the rest, and £22,094 has been paid.

CITY NOTES.

London Electric Cab Company.

Mr. H. H. Mulliner (chairman) presided over a general meeting of the shareholders of the London Electric Cab Company, held on Monday at the Westminster Palace Hotel, and in moving the adoption of the report, said the reason the meeting had not been called at an earlier date was that the board might present the result of a full year's working, and also that they might be able to announce that the new premises were completed, and that the machinery for making the electricity was in full working order. The premises were now completed, and the electrical plant and machinery had been running about three weeks, and was entirely satisfactory. They were also anxious to get completed some new arrangements respecting accumulators, and that morning those arrangements had been completed. At the statutory meeting it was pointed out that, in the opinion of the directors, it was certainly advisable, even at the risk of being blamed for not getting to work quickly enough, to proceed with the greatest caution. Nothing would have been easier than to have put in hand a large number of cabs; but in a new industry like that, they would have found themselves in an awkward position to have spent all their capital, and then not have had perfect cabs. They commenced by building 12 cabs; but although these cabs were praised sky high both by the general and scientific press, they who were behind the scenes knew they were not perfect for their requirements. Some of those cabs were altered, and they built some new ones, until they had 24 in use. The public "caught on," and the cabs were in enormous demand, and they were used probably more than any hansom with two horses in London. Those cabs were a great improvement, but still they were not satisfied. They started a system of entering every complaint and every breakdown whatever, and the number of those breakdowns and complaints at the time made them all very unhappy, and they went to the bottom of each complaint and localised them, and they found they arose from five different causes. It would not be policy to go too minutely into what those causes were, but four of them were mechanical or electrical, and the fifth, which was one of the most serious, was the rubber tyres. The result of their energy in rectifying those complaints was, that they did not now have one-fiftieth of the complaints and troubles that they were having. They had guaranteed the drivers for any loss they might sustain owing to breakdowns, and although they treated that guarantee in a most liberal spirit it was not now costing on an average 1½d. per vehicle per day. There was no doubt that no vehicle in London would satisfy the public in these days unless it was fitted with India-rubber tyres. He recently heard it said by a gentleman on the Continent, who was a large manufacturer of motor carriages, that he was convinced the success of motor carriages in the future depended, not on the accumulators or on the motors, but on the possibility of obtaining a rubber tyre which would support the severe strain He (the chairman) agreed to a large extent with that opinion, for he must admit that a great part of their loss had been in connection with rubber tyres. Shareholders might reasonably complain that this ought to have been realised when the company was formed. Unfortunately, however, they had not had the experience of running 50 miles a day regularly to go on, and he did not think that there was a man living, whatever his knowledge of tyres might have been, who would have realised what they had since found out, viz., the enormous difference in the wear of the rubber tyre of an electrical motor carriage compared with that of a horse-driven vehicle. First, there was the wear owing to the enormous weight; secondly, there was the "creeping" of the tyre caused by the vehicle being propelled by the friction; and thirdly, there was the question of the hardness of the rubber in order to prevent skidding. Of course, there had been plenty of motor carriages built previous to their establishment, including several very successful electrical carriages made under their patents, but no motor carriages except their own, before or since, had been running regularly 50 miles a day, which showed up the weak points, such as in the tyres, which no amount of foresight could have prevented. They experimented with six or seven different sorts with more or less success, and he thought they had now hit upon one which could get over their troubles. The makers also seemed confident about it, as they proposed to guarantee their durability for nine months. Their cabs made slightly more noise than at first, and that was owing to the chain that they had had to substitute for the one they employed at first. At their inaugural meeting, Mr. Preece congratulated them particularly on the chain they were then using, but they found afterwards that it would not stand the severe strain of regular use, and so they had had to substitute the present one. They had also had considerable trouble with their drivers. They did not wish to be unreasonable with the drivers, but at the same time they had the interests of the shareholders to consider. They had had three strikes, but he was pleased now to say that things were on a friendly footing, and that neither side had any grievance against the other. All the drivers were now paying the full Asquith award without any reduction. The intention of the directors was in the future to do all they could to develop the private line trade, which they believed would be more profitable by saving wear and tear and the Scotland Yard license, and from which they would also obtain a slightly increased price. They had some customers—for example, Prince Henry of Orleans—who much preferred their cabs to any form of horse-driven vehicle, and who were willing to hire them for extended periods. They confidently believed that there were many others who would also be glad to do so as soon as it was known that the company was in a position to supply them. They had at least shown a better practical result in the motor industry than the whole of the other motor companies, although their capital was small in comparison to some of them. It had been said that their cabs should have been built differently in every respect, but he would point out that a company had been started in Paris which were giving the same vehicle, built under the same pattern as they had. They had heard a great deal about the French being the pioneers of the motor industry; but as far as electrical vehicles were concerned, they absolutely copied that company. They had also had trouble with the electric current and the accumulators. They started with contracts with the London Electric Supply Corporation for current, and with the Electrical Power Storage Company for cells. The contracts were drawn up with the greatest care, and, to judge from their length and the amount of

argument, one would have thought that every possible contingency had been provided for. But electricity and accumulators were things which were not amenable to contracts, and, as they knew, the unforeseen always happened. He considered that they had been unfairly treated by the London Electric Supply Corporation. Possibly they might have beaten the corporation if they had had a law suit, but it would have been a very big one. However, they had terminated their agreement with them, and had laid down plant for manufacturing their own electricity. That plant had been in working order for a month, and appeared to be extremely satisfactory. Their electricity now was not costing them a quarter of the amount which it was actually costing them before. He said actually costing them because, when they took into consideration loss from the cells standing idle, &c., the actual cost was very different from the nominal cost. Had they from the start obtained their electricity as now, the loss stated in the balance-sheet would have been very different. In order to use the electricity of the London Electric Supply Corporation, they had to go to a large expense to purchase motor generators, but he was pleased to tell them that through the good offices of their consulting engineer they had been able to get rid of them without loss. With regard to accumulators, the Electrical Power Storage Company had given them an immense amount of trouble in the past, but they had now practically settled on a contract which they believed would prove much more satisfactory to both parties. Another scheme had been occupying the earnest attention of the directors, and that was, not to purchase any more accumulators, but to hire them, and that, he thought, would come about. He could assure them, however, that accumulators would not prove a barrier to their success, which so many people confidently predicted when they first formed. They had purchased a piece of land adjoining their premises in Queen Street, and there they were erecting suitable premises. They had now realised that the day of experiments had gone by, and that the undertaking now being a commercial one, a manager must be appointed, and that such manager must have a very considerable knowledge of electricity. They had appointed Mr. J. Grice Statter, who, he believed, would do a great deal for the company. Proceeding to deal with the balance-sheet, the chairman said that of the authorised capital of £150,000, £75,000 was subscribed, and in respect to the last issue, they issued the capital at a premium of 2s. 6d. He knew opinions were divided as to the advisability of that premium, but at the time the cabs were in enormous demand, and they could have supplied a hundred times as many if they had had them, and they did not think new shareholders ought to have come in on the same terms as the old ones. Their new cabs were now nearly all completed, and would all be at work by the middle of January. It was proposed very shortly to make an issue of debentures, and they believed that £12,000 would be amply sufficient; but in order to be on the safe side, the £12,000 would be part of an issue of £15,000, which would be recommended to be issued at a future period if required. The loss stated in the balance-sheet of £6,207 15s. 6d., although stated as a trading loss, must not be looked upon quite in that light. The balance-sheet covered a period of 20 months, and the loss in connection with construction experiments occurred during that time. No one deplored that loss more than the directors. They believed the statements made in the prospectus would be realised, but they had not the knowledge they had now. Their cabs had run nearly 200,000 miles, and nothing approaching that had ever been done before with accumulators. The experience had cost them a good deal, but it would prove a valuable asset. He was as certain now as when the company was started that electrical traction was the future motive power for trade vehicles in London. He thought they might congratulate themselves on the end of their troubles. Their expenses were enormously reduced and experience had taught them what was really required, and they confidently believed that when they met the shareholders next year they would be able to show a far more satisfactory result.

The Hon. Reginald Brougham seconded the motion, and said that the experience they had obtained was, on the whole, not dearly bought. They made inquiries of all the experts, but they found that they really knew nothing about it. They had had absolutely to find out everything they had tried. They thought they were doing a very clever thing when they made the agreement with the London Electric Supply Corporation, but in the end they had had to put down their own plant, and they saved £50 a week. Now things were on a different footing, and he believed next year they would have a very different tale to tell.

Mr. Grein characterised the report as the most disappointing he had ever seen. For nearly two years the shareholders had received nothing to show how the company was going on, and he saw nothing in the chairman's address to account for the disastrous result. He thought the shareholders should have been called together when the new capital was issued and have had the position of affairs explained to them. He would like to know the number of cabs they had, and what were the average receipts, and also the expenses, and then they could form some idea of whether they were likely to work at a profit.

Questions were also asked by Messrs. W. J. Robinson, Fordham, Westwood, Col. Day, and others.

The Chairman, in reply, said the last contract price for making the cabs by the Gloucester Waggon Company was £152. The loss of the company was caused by the troubles they had had. The number of cabs to-day was 71, but they were not all in actual use. They hoped, however, by January 16th that 76 cabs would be in use. As to weight, he could see no way of reducing the weight of the cabs unless someone could invent a lighter accumulator. They had 40 cabs absolutely licensed, but there was no limit to the number of cabs they could put on the streets directly it was an established fact that electric cabs were practical, as they would have no further expense except to buy the new cabs.

The report was then adopted.

The West India and Panama Telegraph Company, Limited.

The report of the directors and the accounts for the half-year ended June 30th, 1898, to be submitted to the forty-third ordinary general meeting, December 14th, 1898, states that the directors submit the accounts for the six months ended June 30th, 1898. The amount to credit of revenue is £39,612 14s. 2d., against £38,209 14s. 4d. for the corresponding half-year of 1897, and the expenses have been £21,704 17s. 5d. against £21,426 17s. 10d., leaving a balance of £17,907 16s. 9d., which, with £721 10s. 10d. brought from last account, makes a total of £18,629 7s. 7d., with which it is proposed to deal as follows:—

	£	s.	d.
First preference shares—			
Dividend, six months to June 30th, 6s. per share ...	10,368	18	0
Second preference shares—			
Dividend, six months to June 30th, 6s. per share ...	1,400	14	0
Ordinary shares—			
1s. 6d. per share (free of income-tax)	6,624	1	6
Balance to current half-year's account	235	14	1
	£18,629	7	7

The shareholders will be glad to know that during the recent war in Cuba and Porto Rico, the cables landed in those islands were maintained in good working order, thus enabling the company to handle an increased volume of traffic arising from press and official messages. The traffic receipts for the six months, as compared with the corresponding period of 1897, show an increase of £6,738 2s. 9d., and the revenue of the current half-year is also considerably in excess of that for the corresponding period, but is tending gradually to resume its normal limits. The expenses of repairing cables during the half-year amounted to £8,907 3s. 4d., being £143 3s. 9d. more than those for the corresponding period. The directors have pleasure in stating that, during the current half-year, the new cables referred to in the last report, have been successfully laid between Grenada, St. Lucia, and St. Croix, in substitution for the old Trinidad-St. Croix line, and that the Trinidad-Grenada section has also been duplicated. The laying of these cables has considerably strengthened the company's duplicate system. The shareholders are aware that in September a disastrous hurricane passed over Barbados and St. Vincent, causing great loss of life and property and wide-spread suffering and distress. Feeling confident of the shareholders' approval, the directors immediately forwarded to the Lord Mayor's Relief Fund a donation of 250 guineas in order to express the sympathy of the company in the heavy calamity that had befallen those islands. The messages relating to the relief of the distress have been sent free of charge over the company's system, and the directors succeeded in having this privilege extended across the Atlantic. Two of the company's cables at St Vincent were interrupted, and the landlines in Barbados, St. Vincent and St Lucia were wrecked by the hurricane, entailing considerable expense for repairs.

British Electric Traction Company.

An extraordinary general meeting of the members of the British Electric Traction Company, Limited, was held yesterday week, at Donington House, Norfolk Street, W.C., under the presidency of Sir Charles Rivers Wilson, G.C.M.G., C.B.

The Chairman said: We have called you together to meet the requirements of the Light Railways Act, which in this respect follows the procedure of the ordinary Railways Acts in requiring that the approval of the shareholders should be signified to any applications to Parliament, and for this purpose a special meeting (called a Wharncliffe meeting) must be held. We are met to pass a series of resolutions approving the drafts of several Light Railway Orders which are in process of being promoted by the company. These are the Light Railway Orders for Merthyr Tydvil, Kinver, Poole and District, South Staffordshire, Doncaster and District, Barnsley and District, Middleton Extensions, Colchester, Spen Valley, and Dudley and District (Extension). We believe this Merthyr undertaking will be a very satisfactory one, as we not only propose to carry out a light railway or tramway scheme, but to combine with it the business of supplying electricity for lighting and other purposes, and the local authorities have already approved our scheme. The Kinver Order is for an extension of the large scheme of tramways and light railways which we have been working up in the South Staffordshire district. We are amalgamating a number of tramways which have been working by steam or horse-power, and we are making extensions and junctions, and propose to work the whole of the undertakings by electricity on a uniform system, to the great benefit of the districts, and, we believe, to the benefit of the shareholders in this company. The Kinver extension will, we think, be especially appreciated because it will extend the tramways of South Staffordshire. The Poole and District Order has also already been approved by the Light Railway Commissioners. The South Staffordshire Order is for making extensions in connection with the scheme I have already referred to. The Doncaster, Barnsley, Colchester, and Spen Valley projects are new schemes, which we hope to be able to carry through. The Middleton Order is an extension of that Middleton Order which we have already secured. The Dudley and District Order is for an extension of a light railway which has already been sanctioned by the Board of Trade. The directors are satisfied

that all these Orders, if secured, will bring good business to the company. As it will probably be three months before the accounts for the year and the general report of the directors will be in your hands, I may—although there can be no other business transacted at this meeting than that of which notice has been given—be permitted to say that the general position of the company is highly satisfactory. The business which the company is developing is a very large one, and I believe that when the accounts and report for the year are before you, you will have every reason to be satisfied with the progress we have made. With regard to profits, as the accounts for the year will not be made up until after the end of December, I cannot yet put any very definite figures before you. I have no doubt that the directors will be in a position to recommend the payment of a dividend; but you must excuse me if I do not at present indicate what that dividend is likely to be. We are building up a very extensive business, which will require from time to time large amounts of capital; in fact, the larger the capital judiciously expended in the business the better the results will be for the original shareholders. But in order to carry out this policy it is important that we should strengthen the position of the company, so that there may be the fullest security for the debenture-holders and preference shareholders, and the directors feel that in the best interests of the company we should work for this object instead of striving to make the largest possible distributions in the form of dividends. Turning to another subject, I need not say that a company working up so extensive and complicated a business has necessarily had many difficulties to overcome. Our negotiations with local authorities have in some instances given us cause for disappointment, and the delays in completing some of our undertakings have been greater than we would like; but on the whole, as I have stated, we have cause to be satisfied with the progress which has been made. I have mentioned to you to-day a certain number of undertakings for which we are asking for powers; but although these are numerous, they are in addition to a very large number of schemes which have already been mentioned to you, and which are already in progress. I will now ask you to express your approval of the resolutions which have been read to you.

Resolutions approving the propcsed applications for orders for Merthyr Tydvil, Kinver, Poole and district, South Staffordshire, Doncaster and district, Barnsley and district, Middleton, Colchester, Spen Valley, and Dudley and district were then put to the meeting *seriatim*, and approved unanimously.

A Shareholder: Are there any competitors in this kind of business?

The Chairman: Yes, there is great competition; but if it were not for this unfortunate disposition on the part of the local authorities to municipalise there would be room for all. Unless municipalities obtain special powers, they cannot go outside their own boundaries; but there has been a disposition—at least, on the part of one corporation—to go outside their boundaries. There is that disadvantage we shall have to cope with.

The proceedings then terminated.

Prospectuses.

The prospectus of the New St. Helens and District Tramways Company, Limited, has been before the public this week, inviting applications for 16,000 £5 5 per cent. preference shares and 10,000 £5 ordinary shares. The authorised share capital is £130,000.

The St. Helens Tramways are at present worked over about 10 miles of lines by the St. Helens and District Tramways Company, Limited.

The lines belong to the St. Helens Corporation, who have also obtained from Parliament this year powers for the construction of additional lines, and have entered into an agreement with the old company to grant a new lease of the whole of them to that company, or a new company formed to acquire and carry on its business, for a term of 21 years from October 1st, 1898. It has further been agreed between the Corporation and the old company that the whole of the lines shall be worked by electricity, and they are now being equipped for that purpose. It is expected that the first section—from St. Helens to Prescot—will be completed by March next. The Corporation agree to construct, furnish, maintain, and keep in thorough repair the whole of the lines, and the obligations of the company are merely to find the cars and working staff, and pay rent for the lines and a charge for the electric current used. This company has been formed to acquire the whole of the assets of the old company, including the right to take up the new lease, and the cars, engines, and stock-in-trade of the business, as a going concern, and to provide the necessary working capital.

The prospectus contains a report by Mr. A. H. Preece, and adds:—"It will be seen from Mr. Preece's report that he bases his calculations upon a cost of more than 6d. per car mile. But in most large cities in which electric traction has been introduced the cost is found to be much less. Thus, in Milan, Dresden, Paris, Hamburg, Geneva, Halle, &c., it is less than 4d. per car mile. There seems no reason why the cost on the St. Helens system, equipped as it will be with the latest and most economical machinery and appliances, should exceed this amount. The receipts of the old company were about £11,000 per annum, so that Mr. Preece's estimate of the future receipts from five times as many cars, running over double the length of lines, and serving a very much larger population, seems amply justified. The success of every electric tram line opened in this country has been remarkable. The shares of the Blackpool and Fleetwood Tramway Company stand at 60 per cent. premium, and those of the Isle of Man Tramway Company at 40 per cent. premium. The Coventry Tramway Company paid a dividend of 8 per cent. on its first complete year of working."

Mr. Preece estimates the profits on 40 cars at £15,200 per annum. The vendors (the old company) take £100,000 as the purchase price in cash and shares. Among the directors we notice the names of Messrs. J. B. and Jacob Atherton, the largest shareholders in the vendor company. The secretary and offices are:—Mr. J. F. Cutler, tramway depôt, Hall Street, St. Helens. The list closed on Wednesday.

Messrs. Doulton & Co.'s prospectus has also been before the public, and the list closed on Wednesday. The capital of the company is £1,100,000. The company is to acquire the business and property of the well-known firm of Doulton & Co., of the Lambeth Pottery.

The firm are manufacturers of every description of pottery, ranging from bricks to the finest china and the highest art productions.

The drain pipe factories at Lambeth and Rowley Regis are the largest in the world, the total output being over 30 miles per week.

There are also extensive potteries for the manufacture of salt-glazed wares and terra-cotta for architectural purposes, Lambeth-faience, tiles, &c., for internal and external decoration, stoves and fireplaces, plumbago and fireclay crucibles, vessels and apparatus for chemical works, conduits and other stoneware for electrical purposes, and all kinds of sanitary appliances.

The works are situated at Lambeth, Surrey; Burslem and Rowley Regis, Staffordshire; St. Helens, Lancashire; Smethwick, near Birmingham; Paisley; and Paris. The head offices are at Lambeth, where, and on Albert Embankment, there are important business premises and showrooms. At Liverpool, Manchester, Birmingham, and Glasgow are also showrooms and premises.

The proprietor and vendor is Mr. Henry Lewis Doulton, son of the late Sir Henry Doulton. He takes as fully paid in part payment of his purchase-money the whole of the 400,000 £1 ordinary shares, 116,666 of the preference shares, and £116,666 of the debenture stock, and £466,668 in cash.

The balance, 233,334 of the preference shares, and £233,334 of the debenture stock are now offered for public subscription, the preference shares at par, and the debenture stock at a premium of £5 per cent.

Brazilian Submarine Telegraph Company, Limited.—The directors have declared an interim dividend of 3s. per share, or at the rate of 6 per cent. per annum, free of income-tax, for the quarter ended September 30th last, and payable on December 23rd. The transfer books of this company will be closed from December 16th to 22nd, both days inclusive.

National Telephone Company.—It is stated that this company is making a fresh issue of debenture capital to the extent of £330,000 (3 per cent.), part of an authorised total of £2,000,000, of which £1,339,471 has already been issued.

Commercial Cable Company.—A quarterly dividend of 1½ per cent., and a bonus of 1 per cent., have been declared.

Eastern Extension, Australasia, and China Telegraph Company.—The directors have declared an interim dividend for the quarter ended September 30th last of 2s. 6d. per share, free of income-tax, payable on January 14th next.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending December 3rd, 1898, were £143 8s. 3d.; aggregate to date, £13,850 1s. 10d.

The Bradford City Tramways.—Week ending December 4th, 1898, miles of track open, road mileage, 4·7; car miles run, 5,362; number of cars, 16. Receipts, £239 14s. 10d.; total receipts to date, £2,435.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending December 2nd, 1898, were £2,478 5s. 0d.; corresponding period, 1897, £2,206 9s. 10d.; increase, £271 15s. 2d.

The City and South London Railway Company.—The receipts for the week ending December 4th, 1898, were £1,119; week ending December 5th, 1897, £1,097; increase, £22; total receipts for half-year, 1898, £22,637; corresponding period, 1897, £21,881; increase, £756. Miles open, 8¾.

The Dover Corporation Electric Tramways.—The receipts for the week ending December 3rd, 1898, were £140 14s. 4d.; week ending December 3rd, 1897, £77 11s. 0d.; increase, £63 3s. 4d.; total receipts to date, 1898, £7,927 2s. 2d. Miles of track open week ending December 3rd, 1898, 3; week ending December 3rd, 1897, 2. Car miles run week ending December 3rd, 1898, 4,222; week ending December 3rd, 1897, 1,902. Number of cars week ending December 3rd, 1898, 11; week ending December 3rd, 1897, 5.

The Dublin United Tramways Company.—The receipts for the week ending Friday, December 2nd, 1898, were as follows:—D. U. T. Co., horse cars, £1,905 2s. 2d.; ditto, electric cars, £504 7s. 4d.; D. S. D. Co., electric cars, £514 10s. 9d.; total, £2,924 0s. 3d; corresponding week last year—D. U. T. Co., horse cars, £2 401 7s. 4d.; ditto, electric cars, £97 2s. 4d.; D. S. D. Co., electric cars, £333 7s. 6d.; total, £2,831 17s. 2d.; increase, £92 3s. 1d.; aggregate to date, £88,549 14s. 10d.; aggregate to date last year, £82,146 0s. 3d.; increase to date, £6,403 14s. 7d. Worked:—The mileage open is 16 miles electrically, 28 miles by horses, as against 11 miles electrically, and 31 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways.—The receipts for the week ending November 30th, 1898, were £209; total receipts to date, 1898, from June 29th, £5,881. Miles of track open, 8½. Car miles run, 3,615. Number of cars, 10.

The Liverpool Overhead Railway Company.—The receipts for the week ending December 4th, 1898, amounted to £1,317; corresponding week last year, £1,286; increase, £31.

The South Staffordshire Tramways Company.—The receipts for the week ending December 2nd, 1898, were £610 14s. 3d.; week ending December 3rd, 1897, £562 17s. 5d.; aggregate receipts for 48 weeks, £30,349 16s. 4d.; last year £30,425 12s. 1d.

The Western and Brazilian Telegraph Company, Limited.—The receipts for the week ending December 3rd 1898, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £3,159.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation, Nov. 30th.	Closing Quotation, Dec. 7th.	Business done during week ended Dec. 7th, 1898. Highest.	Lowest.
127,400£	African Direct Telegraph, 4 % Debs.	100	4 %	...	...	101 —105	101 —105	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs. Red.	100	...	...	...	92 — 95	92 — 95	...	...
905,560£	Anglo-American Telegraph	Stock	£2 9s	£2 13s	3 %	64 — 67	64 — 67	64½	...
3,047,220£	Do. do. 6 % Pref.	Stock	£4 18s	£5 6s	6 %	114½—115½	114½—115½	115½	114⅜
3,047,220£	Do. do. Deferred...	Stock	...	...	...	16 — 16½	16½— 16⅝	16 11/16	16 5/16
130,000	Brazilian Submarine Telegraph	10	7 %	7 %	7 %	15¼— 15⅝	15¼— 15⅝	15⅝	15 7/16
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	5 %	...	...	111 —115	111 —115	111¼	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	4 %	2⅜— 3½	2⅜— 3½	...	...
10,000,000$	Commercial Cable	$100	7 %	8 %	8 %	180 —190	180 —190	...	...
918,297£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	105¾	104⅝
224,850	Consolidated Telephone Construction and Manufacturing	10/-	1½ %	2 %	...	1/16— 3/16	1/16— 3/16	...	...
16,000	Cuba Telegraph	10	8 %	8 %	7 %	10 — 11 xd	10 — 11 xd	10⅝	10½
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	16½— 17½	16½— 17½xd	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 11	10 — 11	...	...
30,000£	Do. do. 4½ % Debs., Nos. 1 to 6,000 ...	50	4½ %	4½ %	4½ %	105 —108%	105 —108%	...	...
60,710£	Direct United States Cable	20	2½ %	2½ %	...	11½— 12	11½— 12	11⅝	11⅜
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	103 —106	103 —106	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	...	...	...	172 —177	172 —177	176½	174½
1,295,000	Do. 3½ % Pref. Stock	100	...	...	...	104 —107	104 —107	106	105
500,000	Do. Prov. Certs., 50 % paid	...	...	...	...	53 — 56	54 — 57	...	...
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	5 %	101 —104	101 —104	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4 %	124 —128	124 —128	126	124
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	17¼— 17⅜	17¼— 17⅜	17⅜	17½
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	5 %	101 —105	101 —105	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	5 %	102 —105	102 —105	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	125 —129	125 —129	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	...	101 —105	101 —105	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	...	102 —105	102 —105	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	4 %	...	103 —106	103 —106	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	4 %	...	103 —106%	103 —106%	...	...
180,227	Globe Telegraph and Trust	10	4½ %	4½ %	4½ %	12¼— 12¾	12¼— 12⅜	12½	12 5/16
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	16½ 17	16½ 17	17⅛	16 11/16
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	10 %	28½— 29½	28½— 29½	...	...
150,000£	Do. do. do. do. 5 % Debs. ...	100	5 %	5 %	5 %	100 —103	100 —103	...	...
97,800	Halifax & Bermuda Cable, 4½ % 1st. Mt. Dbs., w'n. 1-1,200, rd.	100	...	...	...	101 —104	101 —104	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	54 —57	54 — 57	56½	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	6 %	109 —112	109 —112	...	...
484,597	National Telephone, 1 to 484,597	5	5½ %	5½ %	6 %	5½— 5⅝	5½— 5⅞	5⅝	5 9/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	13⅜	13¼
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5½— 5⅝	5½— 5⅝	5⅝	...
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	100 —105	100—103	101¾	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅝— ¾	⅝— ¾	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	4 %	105 —108	105 —108	...	...
11,839	Reuter's	8	5 %	5 %	5 %	7 — 8	7 — 8	7	...
3,381	Submarine Cables Trust	Cert.	...	...	...	133 —138	134 —139	136	135
58,000	United River Plate Telephone	5	4 %	5 %	6 %	4½— 4⅝	4½— 4⅝	4⅝	4 9/16
151,733£	Do. do. 5 % Debs.	Stock	5 %	...	...	103 —106	104 —107	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	5 %	99 —102	99 —102	100	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	⅛— ¼	⅛— ¼	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	103 —106	103 —106	...	...
64,269	Western and Brazilian Telegraph	15	3 %	2 %	3½ %	12¼— 12⅜xd	12¼— 12⅜xd	...	...
33,129	Do. do. do. 5 % Pref. Ord.	7½	5 %	5 %	5 %	8 — 8½xd	8 — 8½xd	...	...
33,129	Do. do. do. Def. Ord.	7½	1 %	nil	½ %	4 — 4½xd	4 — 4½xd	...	...
389,521	Do. do. do. 4 % Deb. Stock Red. ...	Stock	...	...	...	107 —110	107 —110	...	...
88,321	West India and Panama Telegraph	10	⅞ %	1 %	⅞ %	1⅛— 1⅜	1⅛— 1⅜	1 3/16	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	6 %	9½— 10	9½— 10	9⅝	9⅝
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	6 %	7 — 9	7 — 9	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	5 %	106 —109	106 —109	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	6 %	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	5 %	6 %	7 %	11½— 12½	11½— 12½	11⅞	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	...	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	5 %	6 %	8 — 9	8 — 9	8⅝	...
60,000	Do. do. do. 4½ % Deb. Stock Red....	Stock	4½ %	4½ %	4½ %	114 —116	114 —116	...	...
50,000	City of London Electric Lighting, Ord. 40,001—90,000 ...	10	5 %	7 %	10 %	24 — 25	24½— 25½	25⅛	24 13/16
10,000	Do. Ord. Nos. 90,001 to 100,000	10	...	...	...	23½— 24½	24 — 25	...	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	15½— 16½	15½— 16½	16½	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	127 —132	127 — 132	130½	...
30,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—30,000	10	nil	nil	nil	12½— 13½	12½— 13½	13½	...
10,000	Do. do. do. Nos. 30,001 to 40,000 £8 paid.	10	...	...	...	10 — 11	10 — 11	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	14½— 15½	14½— 15½	14⅞	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	...	5 %	5 — 5½	5 — 5½	5⅛	...
15,661	House-to-House Electric Light Supply, Ord., 101 to 15,761	5	...	...	4 %	9 — 10	9 1/16— 9 7/16	9 9/16	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	7 %	9½— 10½	9½— 10½	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3½— 4	3½— 4	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	...	6 — 6½	6 — 6½	...	...
62,400	*Metropolitan Electric Supply, 101 to 62,500	10	4 %	5 %	6 %	16½— 17½	17 — 18	18	17
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	4½ %	117 —121	117 —121	...	...
6,452	Notting Hill Electric Lighting	10	2 %	4 %	6 %	15½— 16½	16 — 17	...	...
31,980	*St. James's and Pall Mall Electric Light, Ord.	5	7½ %	10½ %	14½ %	16½— 17½	17 — 18	17½	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	...	...
50,000	Do. do. 4 % Deb. Stock Red. ...	Stock	...	...	4 %	105 —108	105 —108	...	...
65,000	South London Electricity Supply, Ord., £3 paid	5	...	...	...	2⅞— 3⅛	2⅞— 3⅛	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	7 %	9 %	12 %	16 — 17	16 — 17	16⅜	16⅜

* Subject to Founder's Shares.
‡ Unless otherwise stated all shares are fully paid.
† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.
§ Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation Nov. 30th.	Closing Quotation Dec. 7th.	Business done during week ended Dec. 7th, 1898. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	...	...	...	3¼— 3½	3¼— 3⅜	3½	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	94 —100	94 —100	...	...
30,000	British Electric Traction	10	...	...	...	16 — 17	16 — 17	16⅜	16¼
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	12½— 13½	12½— 13½	13¼	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	2⅓%	*nil*	*nil*	1⅜— 2	1⅜— 2	1⅞	1⅜
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	3 %	*nil*	4 %	2⅛— 2⅜	2⅛— 2⅜	2 5/16	2⅛
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	111 —115	111 —115	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	102 —105	102 —105	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	...	...	...	9½— 10½	9½— 10½	10¼	10 1/16
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	111 —114	111 —114	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	9⅜— 10¼	9⅜— 10¼	10	...
178,303	Do. do. do. £6 paid	10	...	...	...	5⅞— 6¼	5⅞— 6¼	...	...
61,033	Do. do. Pref. half-shares £1 paid ...	...	...	...	...	1¼— 1⅜	1¼— 1⅜	...	...
71,447	Do. do. Def. do. £5 paid ...	...	...	...	...	4½— 5	4¼— 4⅜	...	...
630,000*l*	City and South London Railway	Stock	1 3/16 %	1 1/16 %	1⅛ %	65 — 68	65 — 68	66	65
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 £4 pd.	10	...	...	...	3¼— 4	3½— 4	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	1½— 2	1½— 2	...	...
82,850	Do. 5% 1st Mort. Reg. Debs., 1 to 743 of £100, and 901 to 1,070 of £50 Red.	...	...	...	...	91 — 96	91 — 96	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5 %	5½%	6 %	2 — 2⅓	2 —	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5 %	5½%	6 %	4 — 5	4 — 5	...	...
194,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	99 —101	99 —101	...	...
110,000	Electric Construction, 1 to 110,000	2	5 %	6 %	6 %	2¼— 2⅓	2¼— 2⅓	2⅓	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	2⅜— 3¼	2⅜— 3¼	3	...
111,100	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	105 —107	105 —107	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	¼— ½	¼— ½	¼	...
67,275	Elmore's Wire Manufacturing, 1 to 69,385, issued at 1 pm.	2	...	...	...	¼— ½	¼— ½	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	10½%	7 %	7 %	10 — 12	10 — 12	...	...
12,500	Henley's (W. T.) Telegraph Works, Ord.	10	8 %	10 %	12 %	20 — 21	20 — 21	21⅛	20¾
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	18 — 19	18 — 19	18¼	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	4½%	4½%	110 —115	110 —115	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21½— 22½	21½— 22½	...	...
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅞%	2⅞%	3½%	9 15/16 — 10 1/16	10 1/16 — 10 3/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	15⅝— 15⅞	15 — 15½	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41	37 — 41	40	38
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	104 —107	104 —107	105	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	...	109 —114	113 —116	116	113

† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 10⅛.
British Aluminium, Ordinary, 10—12; 7 % Pref., 11—13.
House-to-House, 4½% Debentures of £100, 105—108.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 13—13½; 1st Preference Cumulative 6%, £5 (fully paid), 7½—8. Debentures, 107—110. Dividend, 1897, on Ordinary Shares 10%.
National Electric Free Wiring, 10s. paid, 7s. to 9s.
Smithfield Market Electric, 2—4.
*T. Parker, £10 (fully paid), 15.
Yorkshire House-to-House Electricity, £5 Ordinary Shares fully paid, 8—8½. Dividend for 1896—6%.

* From Birmingham Share List.

Bank rate of discount 4 per cent. (October 13th, 1898).

MARKET QUOTATIONS, Wednesday, December 7th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a „ Nitric .. .. .. per cwt.	22/-	22/-	..
a „ Oxalic .. .. .. per cwt.	32/-	33/-	..
a „ Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per ton	37/-	37/-	..
a Ammonia, Muriate (grey) .. per ton	£19	£19	..
a „ „ (white) .. per ton	£26	£26	..
a Bleaching powder .. .. per ton	£5 15	£5 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. .. per ton	£16	£14 10	£1 10 inc.
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a „ (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£19 10	£19	10/- inc.
a Lead, Nitrate .. .. .. per ton	£23 10	£23 10	..
a „ White Sugar .. .. per ton	£30 10	£30 10	..
a „ Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	8¼d.	8⅜d.	⅛d. dec.
a „ Caustic (75/80 %) .. per ton	£24	£24	..
a „ Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	65/-	65/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6 15	£6 10	5/- inc.
a „ Recovered .. .. per ton	£5 15	£5 10	5/- inc.
a „ Lump .. .. .. per ton	£5 5	£5	5/- inc.
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a „ Crystals .. .. .. per ton	£3	£3	..
a „ Bichromate, casks .. per lb.	2¾d.	3d.	¼d. dec.

METALS, &c.	This week.	Last week.	Increase or Decrease.
b Aluminium Wire, in ton lots .. per ton	£224	£224	..
b „ Sheet, in ton lots.. per ton	£191	£191	..
c Brass (rolled metal 2" to 12") basis per lb.	6¾d.	6¾d.	..
c „ Tube (brazed) .. .. per lb.	8¼d.	8¼d.	..
c „ Wire, basis .. .. per lb.	7d.	7d.	..
f Ebonite Rod .. .. .. per lb.	3/-	3/-	..
f „ Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£66	£67	£1 dec.
g „ Wire (basis price) .. per lb.	8d.	8d.	..
g „ Sheet .. .. .. per ton	£66	£67	£1 dec.
g „ Rod .. .. .. per ton	£66	£67	£1 dec.
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	5/6	5/6	..
h India-rubber, Para fine .. per lb.	3/10½ for'd	3/10½ forw'd	..
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i „ Pig (Cleveland warrants) per ton	50/-	50/-	..
i „ Forgings, according to size per ton	From £11	From £11	..
i „ Scrap, heavy .. .. per ton	45/-	45/-	..
i „ Wire galvanised No. 8 .. per ton	£8 15	£8 15	..
g Lead, English Ingot .. .. per ton	£13 7 6	£13 10 0	2/6 dec.
g „ „ Sheet .. .. per ton	£14 10	£14 12 6	2/6 dec.
l Mica (uncut slabs 8" long) .. per lb.	6/6	6/6	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£7 15	£7 9	6/- inc.
o Platinum .. .. per oz.	£3 1 6	£2 19 0	2/6 inc.
i Steel, Magnet, according to description .. .. .. per ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£86	£86 10	10/- dec.
g „ foil .. .. per lb.	1/3	1/3	..
n „ wire Nos. 1 to 16 .. .. per lb.	1/4	1/4	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	6⅝d.	6⅝d.	⅛d. inc.
„ Flax, 6 or 8 lea... .. per lb.	3⅝d.	3⅝d.	⅛d. inc.
j „ Hemp, 8 ply 10 lbs. .. per lb.	3¼d.	3¼d.	..
j „ „ Russian, 10 lbs. per lb.	4½d.	4½d.	..
j „ Jute, 180 lbs. rove .. per ton	£12	£12	..
j „ Manila, 24 thread .. per ton	£29	£29	..
k Zinc, Sheet (Vielle Montagne bnd.) p. t.	£29 10	£29 10	..

a Quotations supplied by Messrs. G. Boor & Co.
b „ „ „ The British Aluminium Co., Ltd
c „ „ „ Messrs. Thos. Bolton & Sons.
d „ „ „
e „ „ „
f „ „ „ The India-Rubber, G.-P., and Teleg. Works Co Ltd
g „ „ „ Messrs. James & Shakspeare.
h „ „ „ „ Jackson & Till.
i Quotations supplied by Messrs. Bolling & Lowe.
j „ „ „ „ Henry C. Yeo & Co.
k „ „ „ „ Morris Ashby, Limited.
l „ „ „ „ Sanders, Wake & Co.
m „ „ „ „ W. T. Glover & Co., Ltd.
n „ „ „ „ P. Ormiston & Sons.
o „ „ „ „ Johnson, Matthey & Co., Ltd

LONG DISTANCE TRANSMISSION OF ELECTRIC POWER.*

By Prof. GEORGE FORBES, F.R.S., M.Inst.C.E.

(*Concluded from page* 847.)

The same remarks apply to the meaning of the voltage of the line in all the curves and tables referred to. They are worked out for continuous current, and for any other system the engineer must add the usual corrections.

Another curve may be drawn showing the inefficiency at each current density. This curve constantly rises, *i.e.*, the greater the current density, the greater is the inefficiency.

Now from these two curves we can deduce a third curve, which is the one which I find gives one in a few minutes all the main facts one wants for any horse-power to be delivered to any distance at any initial volts.

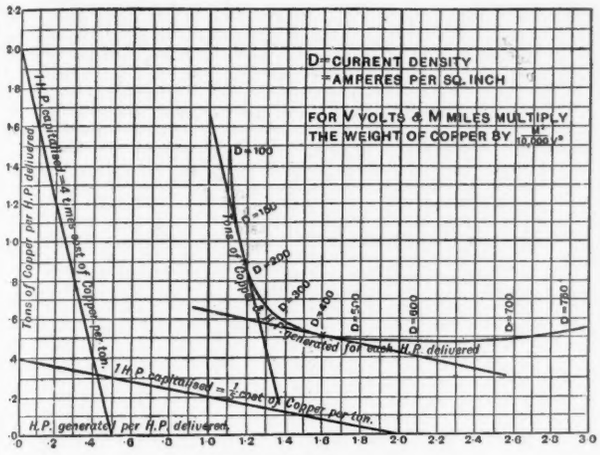


Fig. 2.

Electric Transmission Curve for 100 Miles at 10,000 Volts Continuous Current.

This curve gives the tons of copper per horse-power delivered at 100 miles with 10,000 volts continuous current, in terms of the horse-power generated per horse-power delivered.

Measuring along a horizontal line you get the inefficiency, *i.e.*, the horse-power generated for each horse-power delivered; and measuring vertically you get the corresponding tons of copper required for each horse-power delivered, at a distance of 100 miles.

The curve is also marked with figures to show the current density in amperes per square inch section of copper.

I never travel a day without this curve in my pocket.

This curve is correct for 100 miles and 10,000 volts, or for any other case where the volts = 100 times the miles. The curve shows you, for example, that for an inefficiency of 1½ you require a current density of 387 amperes per square inch, and ·55 tons of copper. And thus current density and weight of copper per horse-power is the same, whether you use 10,000 volts at 100 miles or 100 volts at 1 mile.

For any other volts and distance in miles, v and m, you divide the volts by the miles and get $\frac{v}{m}$; then $\frac{v}{100\,m}$ = d, the multiplier for the current density, and $\left(\frac{v}{100\,m}\right)^2$ = t the divisor, for the tons of copper per horse-power.

As an example, 15,000 volts and 300 miles. Here $d = \frac{15{,}000}{100 \times 300} = \frac{1}{2}$. Hence for an inefficiency as above of 1½, the current density will be ½ × 387 = 198. The tons of copper per horse-power will be $\frac{\cdot 55}{(\frac{1}{2})^2} = 2{\cdot}20$ tons.

Now let me show another use of the curve. Suppose we capitalise the cost of running the generating station, and add to the cost of the generating works, and divide by the horse-power, we have then the capitalised value of 1 horse-power generated; I will call it for short the value of 1 horse-power generated. We also know the cost of one ton of copper. Divide the value of the horse-power by the value of the ton of copper, and draw a line across the axes so that it cuts the axes in that ratio. Draw a line parallel to this and touching the curve. This gives you, according to Lord Kelvin's law (as modified by Ayrton and Perry) the point of maximum economy giving directly the inefficiency, the tons of copper per horse-power and the current density. Thus on the curve two examples are shown, one where the value of 1 horse-power is four times that of a ton of copper. In this case the greatest economy is got by an inefficiency of 1·18, a current density of 180 amperes per square inch, and 0·91 tons of copper per horse-power delivered at 100 miles distance, the initial pressure being 10,000 volts.

Another example is shown on the curve where the horse-power is ¼th of the cost of a ton of copper. The resulting values are seen directly to be—Inefficiency = 1·58; current density = 420; copper = 0.51 ton.

To do this for other values of t

$$\left(t = \left(\frac{100\,m}{v}\right)^2\right)$$

you must divide the value of the horse-power by t. Measure this distance vertically by the unit on the vertical scale or by fractions of these units, and measure the cost of a ton of copper horizontally by the unit on the horizontal scale or by the same fraction as before of that unit. Join the two points by a line and draw a parallel line touching the curve at the point of maximum economy.

You will see now how valuable such a curve must be for obtaining the very information that an engineer requires in his first examination of any project. But we can do more than this. Divide the tons of copper per horse-power by 18 times the distance in miles, and you get the sectional area in square inches of the conductors (go and return) per horse-power. Multiply this by the total horse-power to be delivered, and you get the size of your conductors.

N.B.—Remember that this is all worked out for continuous current, and must be corrected for other systems as well as for temperature and sag.

Some people prefer to work by tables instead of by curves, so I will put down the readings of the curve which we have just been discussing. For ordinary work the following is sufficient:—

Inefficiency.	Tons copper per horse-power.	Current density.
1·20	·86	190
1·30	·66	266
1·40	·58	330
1·50	·55	387
1·60	·51	432
1·70	·49	475
1 80	·48	510
1·90	·472	545
2 00	·470	574

In most practical cases, however, the economical inefficiency for long distance transmission lies between 1·20 and 150. The following Table gives closer values over this range:—

Inefficiency.	Tons.	D nsity.
1·20	0·86	190
1·22	0·80	207
1·24	0 76	221
1·26	0 72	236
1·28	0 69	250
1 30	0 66	265
1·32	0 64	279
1·34	0 62	292
1·36	0·60	306
1·38	0 59	319
1·40	0·58	330
1·42	0·57	342
1·44	0·56	354
1·46	0 55	365
1·48	0·54	376
1·50	0·53	387

From either of these Tables, having given the inefficiency, to get the density for any volts and distance, multiply the above value by $\frac{v}{100\,m}$, and to get the tons of copper, divide the above value by

$$\left(\frac{v}{100\,m}\right)^2$$

This little Table enables us, then, with a very simple piece of arithmetic, to get the result for any case that may arise, sufficiently close.

But in actual practice I find it far more useful to have the Table extended in such a way that an approximate result may be arrived at without any calculation.

Three Tables are here given. The first gives a reference letter for any volts and distance. In the second and third Tables, the results we want are found under that reference letter. The second Table gives the tons of copper per horse-power delivered, and the third gives the current density for any inefficiency that we may select.

Rules for Using the Tables.

Rule I.—*To find the Reference Letter.*—In Table I., in the column referring to the volts generated, find the approximate distance of transmission in miles. The capital letter at the beginning of the line in which this is found is the reference letter.

Rule II.—*To find the Tons of Copper per Horse-power Delivered.*—Look along the row in Table II. referring to the reference number, and tons of copper are there given for each inefficiency. The inefficiency being the horse-power generated to deliver the horse-power at the distant point.

* Society of Arts, November 23rd.

Rule III.—*To Find the Current Density.*—Table III. gives this in amperes per square inch in the row corresponding to the reference number, and in the column corresponding to the inefficiency chosen.

Rule IV.—*To Find the Economical Conditions of Working (Kelvin's Law).*—Divide the capitalised value of one horse-power by the cost of 1 ton of copper. Divide this by 10 and call it q. In Table II. look along the row corresponding to the reference letter until the difference between successive numbers is approximately q. The number at the head of that column is the economical inefficiency, the tons are also then given, and the current density is obtained directly in Table III.

Rule V.—*To Find the Total Section (Go and Return) of all the Transmission Conductors.*—Multiply the tons per horse-power by the total horse-power, and divide by 18 times the distance in miles. This is the result in square inches. Dividing this by the number of conductors gives the sectional area of each.

Table I.—Distance of Volts.

	Virtual volts between wires.					
1 or 2 phase..	5,000	10,000	15,000	20,000	25,000	30,000
3 phase ..	4,325	8,650	12,975	17,300	21,625	25,950
	Distances in miles.					
A	12·5	25	37 5	50	65 5	75
B	25	50	75	1 0	125	150
C	37 5	75	112 5	150	187 5	225
D	50	100	150	200	250	300
E	62 5	125	187 5	250	312	375
F	75	150	225	300	375	450
G	87·5	175	262 5	350	437 5	525
H	100	200	300	400	500	600
K	150	300	450	6 0	750	900

Table II.—Tons of Copper per Horse-power Delivered.

Inefficiency.	1·2	1·3	1·4	1·5	1·6	1·7	1·8	1·9	2·0
A	0537	0412	·0362	·0344	·0319	·0306	·0300	·0295	·0294
B	·2150	·1650	·1450	·1375	·1275	·1225	·1200	·1180	·1175
C	·4837	·3725	·3262	·3094	·2869	·2756	·2700	·2655	·2644
D	·8600	·6600	·5800	·5500	·5100	·4900	·4800	·4730	·4700
E	1·344	1·031	·9062	8594	·7969	·7656	·7500	·7375	·7344
F	1 935	1 499	1 305	1 237	1·148	1·102	1·080	1·062	1·058
G	2·634	2·020	1·776	1·6 4	1·562	1·504	1·470	1 446	1·439
H	3·440	2·640	2·320	2·200	2 040	1·960	1·920	1·888	1·880
K	7·740	5·940	5·220	4·950	4·590	4·410	4·320	4·248	4·230

Table III.—Current Density.

Amperes per square inch.

Inefficiency.	1·2	1·3	1·4	1·5	1·6	1·7	1·8	1·9	2·0
A	760	904	1,320	1,448	1,728	1,900	2,040	2,180	2,296
B	380	452	660	724	864	950	1,020	1,090	1,148
C	253	301	440	515	576	633	680	727	765
D	190	226	330	387	432	475	510	545	574
E	152	181	264	310	346	380	408	437	459
F	127	151	220	258	288	317	340	363	383
G	108	129	188	221	246	271	292	311	327
H	95	113	165	193	216	237	255	272	287
K	63	75	110	129	144	158	170	182	191

I trust that I have not wearied you with these arithmetical conundrums. All I can say is, that I have found them of the greatest use, and I shall be very pleased if some of you do so also.

I trust that all here present who are not engineers realise now that the cost of transmission of electric power to a distance is a pure question of balancing expenditure and profits. By the methods now described, or by the ordinary methods, there can be no question as to the cost of the work. The only point, in fact, affecting the cost which has been left to the choice of the engineer, is the electric pressure to be used, and every engineer in reporting on a scheme generally gives his reasons for selecting the pressure. In old days, the highest pressure for which we could get a guarantee from contractors was used. But the expense of insulation increase as much with increase of pressure that now, as at Rheinfelden, we work to that pressure which is the most economical. Manufacturers will now guarantee any pressure if you will pay for it.

Having now determined with sufficient accuracy the cost of the works and their maintenance, annual expenses and interests on mortgage, the next thing is to see (or, perhaps, this ought to be the first matter attended to) what return can be obtained for the power delivered to a distance. It is then for the purely financial men to say whether the profits to be derived are worth the venture.

It has been my object to-night to put before engineers some useful rapid methods for arriving, on the ordinary lines of working, at the data for any special case of long distance transmission of power. It has also been my object to show that those who carry out such schemes do not require to be handicapped by the enormous capital which has hitherto been generally considered necessary. Incidentally it would appear that whenever gold mines exist which can afford to pay 5s. or 6s. per ton of ore milled, and if there be good water-power within 400 miles of the mines, it is most probable that it will pay well to transmit the power electrically.

If I have convinced any doubters that simply in my limited experience I have found many cases where it will pay well to transmit power to distances of several hundred miles, then my purpose is served, and I shall be glad that I have brought this subject to your notice.

Discussion.

The Chairman said there were two matters of which there could be no doubt—first, that Prof. Forbes had brought forward a most suggestive and valuable paper upon a subject which was pressing on the minds of many people in all parts of the world; and secondly, that engineering was a most delightful profession. He was sure all those who belonged to it would agree with him, and those who did not belong to it, after hearing this paper, would be more envious than ever of those who did. The profession of the civil engineer had been defined as that of one who directed the great forces of Nature for the use and convenience of man, and engineers were brought into contact with so many interesting subjects, localities, and people, that they were all happy to belong to such a profession. One of the matters which pressed on the mind of the engineer was the conservation of energy. It might take the form of capturing the power which existed in and came from the clouds in the form of rain, and was found in rivers or stored in reservoirs; it might harness the winds and make them serve the use of man; proposals had even been made to capture the force running to waste in the waves; and there was the very seductive proposal of directly capturing the electricity in the air, due to terrestrial magnetism or electricity. All these subjects were germane to the interesting question brought forward that evening, because in so many cases the conservation of energy was not of much use unless there was also the power to transmit it to the place where it could be used. For instance, in Scotland, the valley of Ben Nevis had a rainfall of 10 feet per annum, which represented an enormous force at present unused. If that could be captured at a reasonable cost for storage, and transmitted to a distance, what a great future seemed to lie before future generations. It was rather startling to hear of £100 being paid per horse-power, but figures had been given showing that gold mining could afford to pay even that figure. In England one expected to get horse-power at £5 or £6 per annum by the storage of water, but he would not go into those details, nor yet into the financial question, except to suggest that the idea of a mortgage at 4 per cent. on copper, which was spread over 400 miles in Central Africa, seemed to him rather hypothetical. No doubt the value of the copper was there, but whether capitalists would be ready to lend money on it at 4 per cent. under those circumstances he had some doubt about it. He was not an electrician, and would not attempt to follow the figures and diagrams, but they seemed to be of the greatest possible value to those who had to deal practically with this subject, and they must all be grateful to Prof. Forbes for giving them such means of forming a judgment on the problem which was at first sight so intricate as that of the transmission of electric force for distances of 400 or 500 miles.

Colonel Gouraud expressed his regret that there was not as large an audience to hear this paper as thronged the room and its

approaches some years ago when he read a paper on the phonograph, and said he thought the present subject, if not at first sight so fascinating, had more money in it, and it was a great pity the hall was not filled with capitalists and financiers. He was glad to be again in England, after an absence of some years, and he well remembered, about four years ago, meeting Prof. Forbes at Niagara Falls amidst a crowd of the greatest men of science and finance of both hemispheres gathered together in connection with the great scheme of utilising that enormous water-power for the creation of electric energy to be transmitted at a distance of 25 miles to Buffalo. Three years later he found himself again—one Sunday evening—at Buffalo, and he heard as a secret that that night the long-looked for transmission of power was to take place. He at once telegraphed to Niagara for permission to be present, but it was not accorded, and he then cabled over to the *Times*, got authority from the editor to represent the paper on the occasion, and ultimately, after some difficulty, got admission to the works, saw the first motion of the machinery, and a few minutes after 11 sent off his message to the *Times*, which was published in London before the news was printed in the Buffalo papers. He was much struck with the proposal as to the division of capital, having, in times past, had a good deal to do with the financing of electric companies. He well remembered one company with a very long name, of which he was vice-chairman, which had a capital of a million, the object being to advance money to people who had central station schemes, this being at the time of the boom, just after the electric light exhibition in Paris and at the Crystal Palace. For about a year the board met nearly every week, but their two managing directors who examined the schemes which were sent in, were not able to report favourably of any of them, and at the end of the time the capital was returned to the subscribers. With regard to mortgages on copper in the centre of Africa or Australia, he did not think there was much of a market for it there, but even adding the cost of transportation, it might be a good investment.

Mr. G. L. Addenbrooke said this was a subject to which he had paid a good deal of attention during the last few years, but the form in which it was presented almost took one's breath away. He did not wish, however, to say anything derogatory of the view put forward, for which they were much indebted to Prof. Forbes. There were no doubt many large sources of water-power in various parts of the world, and in time they might be utilised, but he might point out that for many purposes the cost of electric power was much the same whether generated by steam or water-power. If these great waterfalls were used in this way, it might lead to an enormous shifting of population, and some of the great centres of industry at present might be destroyed. The question was whether there was any danger of this, and whether anything could be done to enable existing manufactories and populations to remain where they were. What Prof. Forbes said was perfectly feasible. He thought that Englishmen who had not travelled or specially studied the subject had little notion of what had been done in this way abroad. Nothing struck him more at Geneva and one or two other places than the confidence with which capitalists put immense sums into these water-power transmission schemes, especially considering the difference between them and steam-power installations. In the latter case you could start on a small scale; put down, say, 1,000 horse-power and see if there was likely to be a return; but in the case of water-power it was essential to begin on a large scale. At Rheinfelden they put down a plant and obtained 22,000 horse-power, of which perhaps not more than one-fourth was as yet utilised. But they erected immense works, brought in sidings, built a bridge over the Rhine, bought up all the land in the neighbourhood, and advertised that they would sell sites to manufacturers, so that there was an immense amount of capital locked up which could not be immediately remunerative; but they had sufficient confidence in the thing to wait until it was. What had been done there could no doubt be carried out in other places, such as Prof. Forbes had mentioned. The only one with which he had any acquaintance was Western Australia, for while Prof. Forbes was considering the scheme to which he had referred, he (Mr. Addenbrooke) was acting for some people who had a concession for lighting Coolgardie, and had to consider what they should do with it, and whether they would not be swamped by power transmitted from the coast. He came to the conclusion that there was not very much risk of it. Having spent some time in the country, he was fairly conversant with the local circumstances, and ascertained from some large shipping people at what price they could land coal at the nearest port. He also found there were coal fields within 500 miles, which the Government were developing, and which had since been placed in communication by rail. The railways were in the hands of the Government, who were willing to carry coal at ½d. per ton per mile, and he found that they could get coal delivered in Coolgardie at 45s. a ton or less, and at that price he did not think it would pay to generate power on the coast and transmit it. It would be better to generate it on the spot, as they were doing on the Rand, and distributing it up to distances of 20 miles. There the price charged per horse-power was about £45. He mentioned that to show that one of the elements which capitalists would have to consider was the chance of coal being found in the neighbourhood, which might alter the whole of the conditions. At the same time there would be many places where this method of transmitting power would be valuable.

Mr. L. Gaster said that he had visited some institutions in Switzerland, and had seen a steam engine factory where a current of 5,000 volts was transmitted from a river 12½ miles away with an efficiency of 77 per cent., and it was used for all the purposes of the factory. Some time ago Mr. Wallace read a paper at the Society of Chemical Industry on the utilisation of water-power, in which he said that by that means power could be supplied at a profit for £4 per annum per horse-power, which was cheaper than steam. The one requisite was to have a very large central station, as in that way it was produced more economically. For long distances the way to reduce the charge for copper was to increase the voltage. From Lauffen to Frankfort, a distance of 108 miles, a high voltage transmission (although double transformation was used) gave an efficiency at Frankfort of 73 per cent. Large works always produced power more cheaply than small ones, and small manufacturers did better by obtaining their power from such sources than by working independently. Prof. Forbes had shown that long distances were no obstacle, and there was every reason to believe that the time was not far off when this method would be very largely adopted. If England had no great amount of water-power she had cheap coal, and if large central stations were established near the coal pits it would be a great benefit to the people at large.

Mr. W. M. Mordey emphasised the very great technical advances of recent years, which justified the reader of the paper in treating these bold engineering proposals entirely from the commercial standpoint. What will it cost to transmit the power? And what can be got for it? The chairman had given them two propositions. He ventured to give them a third: If you can make the mouths of capitalists water by showing how to make big profits, you produce a water-power of the greatest value. He congratulated Prof. Forbes on having done much to start that power.

Prof. Forbes said he had very little to reply to; and perhaps what he had put forward would be like seed sown in the ground, which in due time might yield a valuable return. He did not think the objections raised were really very serious—not even what the chairman had been good enough to point out, for all the places referred to were not in Central Africa. That question had been fully discussed by himself and the business men before whom he had put the proposition. It was perfectly obvious that something must be laid by for the removal of the copper, and there were many other points which he might have mentioned; for instance, it would be essential that those who held the bonds should have some representative on the spot to see how much copper was put down, and that the value remained, and many other precautions would have to be taken; but these were matters of detail, with which he did not think it necessary to burden the paper. He trusted the view put forward by Mr. Mordey would be generally adopted, that they really had no differences to settle in this matter—at any rate, none worth talking about. The estimates which could be made were like those for building a bridge or any other work; it was purely a question for business men whether it was worth venturing. He thought the scheme of dividing the capital into a speculative and a solid investment was a sound proposition. He should be glad to be able to get 4 per cent. on such a safe investment as this seemed to him to be, and as for the speculative side, he thought 40 per cent. ought to make even a large capitalist's mouth water.

The Chairman then proposed a cordial vote of thanks to Prof. Forbes, which was carried unanimously.

INSTITUTION OF ELECTRICAL ENGINEERS.

"Rotatory Converters." By Prof. Silvanus P. Thompson, D.Sc., F.R.S., Vice-President. (Paper read November 10th, 1898.)

(*Continued from page* 844.)

A large 100-kilowatt two-phase converter, constructed by Messrs. Alioth for Geneva, is described in the *Electrician* of January 8th, 1897, with sectional drawings. This is a 14-pole ring armature machine, having an armature 1 metre in diameter, running at 385

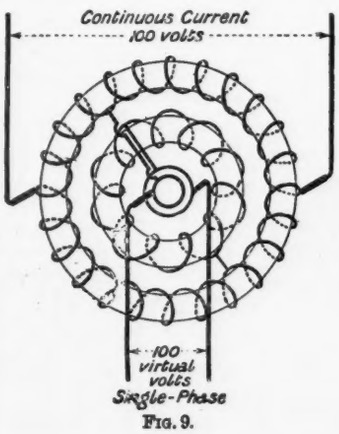


Fig. 9.

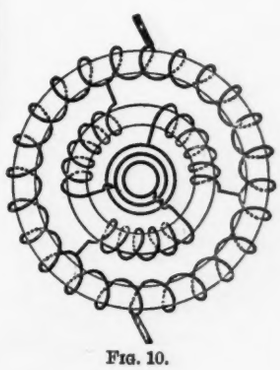


Fig. 10.

revolutions per minute. As it is designed to supply continuous currents to a three-wire distribution, it is wound with two independent converter windings, each capable of supplying 450 amperes at 110 volts; and is furnished with four slip rings, and with a commutator at each end. It has an efficiency of 90 per cent.

The problem of changing into convenient simple ratios the awkward percentage numbers which subsist between the voltages at

the two sides of a converter has engaged the attention of several engineers. Mr. Heldt has described * an ingenious method of obtaining any desired ratio by the device of including on the alternating current side additional windings between the slip rings and the points where these rings are connected up to the armature winding proper. Fig. 9 illustrates the case of a single-phase converter. Here auxiliary windings (in two parallel circuits) are joined in so as to bring up the 70·7 volts on the alternating side to 100 volts, so as to make the voltages alike at both sides of the machine. To adapt this suggestion to the case of a three-phase converter, three sets of auxiliary windings must be intercalated between the three slip rings and the points of connection to the ring windings; these auxiliary windings being chosen, as to number and position, so as to add the desired supplementary voltage. It will be seen that this is equivalent to using a mixed star and delta winding, the delta part being that which alone constitutes the true converter winding. It is uniformly distributed around the core, and is symmetrically connected to the commutator.

Another solution of the problem, of more limited application, lies in so altering the distribution or concentration of the magnetic field at the poles as to change the irregular ratios into more regular ones. It was pointed out above that any concentration of the field will alter the conversion ratio. For example, the ratio in the case of the three-phase converter with sine distribution being 61·23 per cent., if the poles are narrowed a little, this may be raised to 66·6 per cent.; so that a machine which is a 300-volt machine on the continuous current side will be a 200-volt machine on the three-phase side. An example of this is afforded by a four-pole 55-kilowatt converter constructed by the Oerlikon Company, the description of which has been kindly furnished by Dr. Behn-Eschenburg. Drawings of this machine are given in figs. 11 and 12. It was designed to receive continuous current at 300 volts, and to run at 600 revolutions per minute. Its armature is a two-circuit multipolar drum 522 mm. in diameter, 360 mm. long, having 117 slots, and two conductors per slot. It has four sets of carbon brushes, set at zero lead. It runs quite sparklessly at all loads. As originally constructed, the poles were furnished with pole pieces (as shown) each of about 72° span, therefore having a breadth about 80 per cent. of the pole pitch, the chord across the tips being 335 mm. So shaped, the coefficient of conversion was found to be 57·7 per cent., as against the 61·23 per cent. if sine distribution had been present. When supplied at 300 volts on the continuous current side, its open circuit three-phase voltage was only 173

ROTATORY CONVERTER, Type △, IX, A.

Continuous-current side as motor for 300 volts taking about 190 amperes.
Three-phase side as generator at 200 volts, yielding 3 × 159 amperes, with frequency 20 periods.
Core discs 117 slots, with two conductors per slot.
Conductors 234, net section 2·2 × 1·6 mm.
Diameter of core discs, 520 mm.
Commutator, 117 bars.
Brush-holders, four sets, with five carbon brushes per set.
Revolutions per minute, 600.

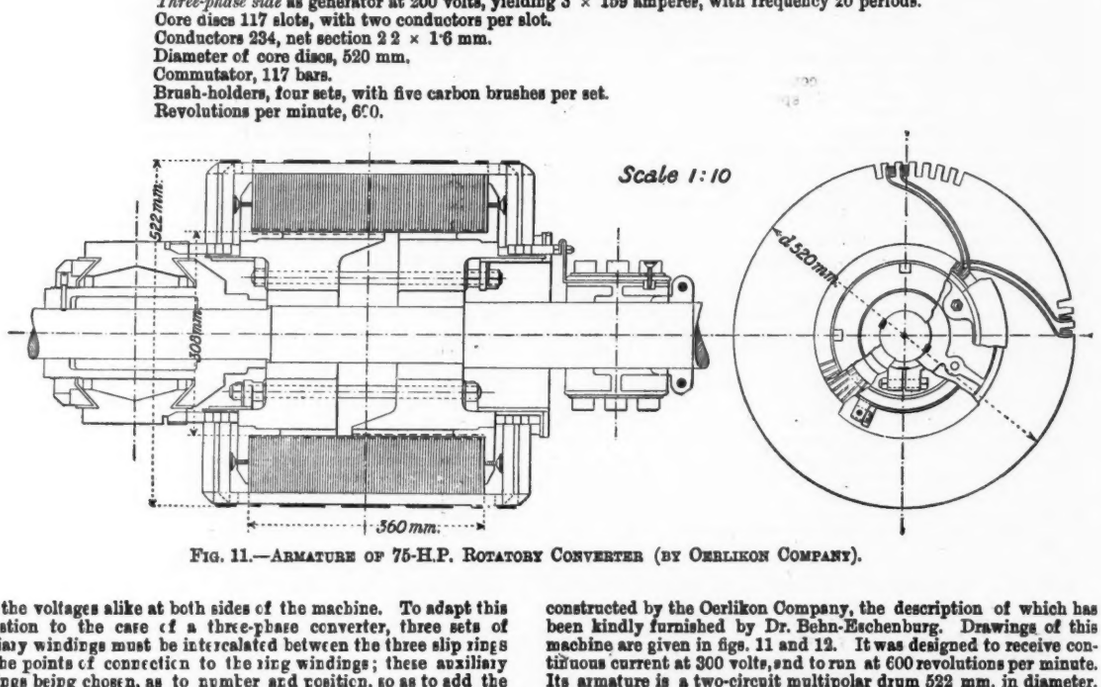


FIG. 11.—ARMATURE OF 75-H.P. ROTATORY CONVERTER (BY OERLIKON COMPANY).

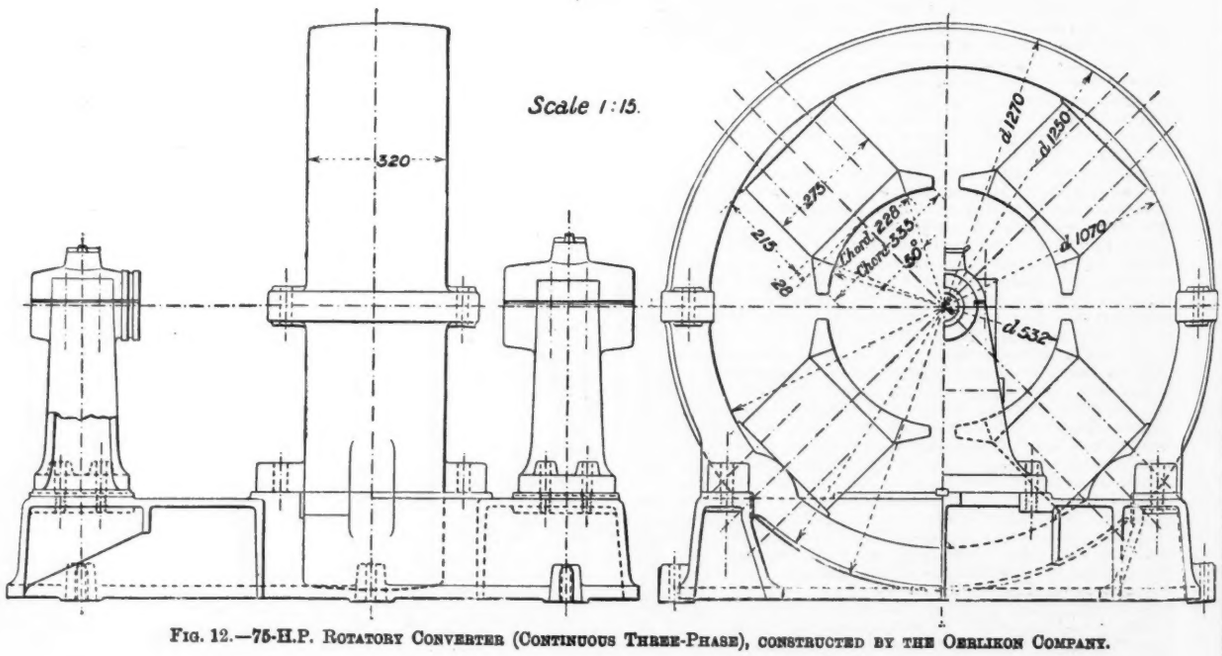


FIG. 12.—75-H.P. ROTATORY CONVERTER (CONTINUOUS THREE-PHASE), CONSTRUCTED BY THE OERLIKON COMPANY.

* See *Electrical World*, Vol. xxviii., 68, July 18th, 1896.

volts. The pole tips were then cut away, as shown in fig. 12, so that the arc of pole span was reduced to a little under 50°, the chord across the tips being now 228 mm., and the pole breadth being 54 per cent. of the pole pitch. This had the effect desired of bringing the conversion ratio up to 66·6, the open circuit three-phase voltage being now 200. The ratio of conversion was constant within 2 per cent. at all loads. Fig. 13 gives a plot of the performance of the machine under different excitations. It will be seen that the ratio of the ordinates is approximately that of 3 : 2. Two other points plotted show the demagnetising reaction due to wattless currents. They affect, of course, the speed and heating of the machine, but practically have no influence upon its ratio of conversion when the excitation of the field magnets is normal. In its original shape, when operated as continuous current motor at 300 volts, with an excitation of 2·1 amperes, without load on the three-phase side, it ran at about 470 revolutions per minute. When loaded so as to give out 153 amperes per phase on an inductionless circuit, the speed fell, in consequence of reactions, to 440 revolutions per minute. At this speed the measurements were: Continuous current side, 295 volts, 153 amperes; on the three-phase side, 165 volts, 3 × 153 amperes. Then the output was changed to one of 235 amperes per phase of lagging current on a load of induction motors running light. The speed went up to 640 revolutions per minute (showing a weakening of the field), and the instruments measured:—Continuous current side, 298 volts, 32 amperes; on the three-phase side, 157 volts, 3 × 235 amperes. To keep the speed, and therefore the frequency, constant under such conditions the (shunt) excitation would need to be adjusted in accordance with the load and its lag.

The pole cores and yoke of this machine are of cast-steel, each pole being wound with 3,200 turns of a copper wire of 2 square mm. section; the total resistance of the shunt winding being 80 ohms. The armature resistance from brush to brush is 0·028 ohm. The machine runs sparklessly with zero lead of the brushes. It will also run as a synchronous motor delivering continuous current sparklessly, with or without excitation of the field magnet, and with brushes set at zero, or set with either a large forward or a large backward lead. With a large backward lead, running synchronously, without excitation, at 627 revolutions per minute, giving out 46 amperes at 100 volts, it took in three currents of 155 virtual amperes (largely wattless) at about 100 virtual volts at the three-phase side. The reactions in this curious case are exceedingly complicated.

(To be continued.)

ELECTRIC RAILWAYS ON THE WEST COAST.

The Town Council of Southport has expressed its approval of plans which have been laid before it for the connection of that town to Lytham by means of a tramway across the estuary of the Ribble.

According to the published description of the plans, it is proposed to extend the present tramway system from the terminus on the promenade to the old sea embankment at Southport, a distance of about three miles; then to build an elevated platform railway, after the style of the Brighton and Rottingdean Railway, along the banks to the southern training wall of the river; from that point to cross the channel to the northern training wall by a kind of aerial flight or suspension railway, like that in use across the harbour at Bilbao, 90 feet above high water; and to reach the East Beach at Lytham by an open ironwork structure fixed in the sands of the river.

From the East Beach only a short length will be necessary to complete the connection of the Southport tramway system to the existing Lytham, St. Anne's, Blackpool and Fleetwood systems, in all a distance of some 36 miles. The total cost of the undertaking, *i.e.*, the crossing of the estuary, is estimated at £300,000, and it is stated a provisional order will shortly be applied for.

The scheme, though not by any means impracticable, is an ambitious one, and certainly speculative. Two years ago a similar scheme—differing, however, in its essential details, we understand—was mooted; but apparently failed to survive its chrysalis stage. What the causes were which brought about its disappearance we do not know. To us it would appear that the present scheme has in it the elements of success; but everything will, of course, depend upon the energy and resources of the promoters.

The chief difficulties to be encountered, so far as we can gather, are more of a financial than of an engineering nature. It should not be a very difficult matter to bridge the estuary in the manner proposed, as the sands are not of a dangerous character, and the work, with the exercise of skill, should readily be accomplished after it has once been put in hand. But the question which overshadows all others is, whether the undertaking will pay. We are not inclined to be too optimistic on the point. It is not as if the places which it is proposed to connect together were busy manufacturing towns with a continuous stream of traffic between them all the year round. They are health resorts, suffering to a large extent from a state of masterly inactivity for nearly six months of the year. And it is extremely doubtful whether the revenue derived during this brief period would be sufficient to cover working expenses and pay even a small dividend on the necessarily large amount of capital involved.

Still, it would be unwise to yield to counsels of despair in this respect. The brilliant and locally unlooked-for financial success of the Blackpool and Fleetwood Electric Tramroad Company, furnishes an example of the results which follow in the paths of enterprise, and an incentive to disregard gloomy forebodings.

We are presuming that the promoters of the scheme under notice have made provision against any interference with the low water channel of the river. If they have not, they would do well to immediately repair this deficiency, otherwise their project is doomed to almost certain failure at the outset. Preston has crippled its financial resources for a generation in a vain endeavour to become a seaport, and anything which threatens to silt up or in anyway interfere with its already too shallow navigable highway is sure to meet with the most determined and undoubtedly successful opposition. Lytham and St. Anne's, too, might confidently be expected to strenuously support the efforts of Preston, if the proposed works are likely to increase the accumulation of sand banks in their vicinity, seeing that the establishment of the river training walls has already been the alleged cause of the accumulation of sand on their foreshores, making the places almost resemble Southport at low water in consequence.

The publication of this project serves to draw attention to the fact that gradually the West Coast of England is being skirted by electric tramways and railways. Starting at Liverpool one is able to proceed a considerable distance towards Southport, and doubtless a through connection to that town will soon be made. Then, if the over Ribble tramway scheme is accomplished, it will be possible to continue the journey along to Lytham, St. Anne's, Blackpool, and Fleetwood. From this point it would only appear to be a question of time—and a short time only—before one will be able to travel along the shores of Morecambe Bay to the rapidly rising town of Morecambe, taking in Lancaster on the way, passing round to Grange-over-Sands, and so into the heart of the beautiful country at the foot of Lake Windermere.

Southwards from Liverpool, too, the lines are slowly but surely being extended along the coast, and doubtless in the course of a few years connection will have been made to the line round the Great Orme's Head, passing through Rhyl, and thence round the coast of Wales.

Probably this is at present a dream, but it is obviously one not incapable of practical realisation. Should it ever be realised, the extraordinary opportunity will be presented of traversing the whole distance from, say, Bangor, in Wales, to Windermere, in Cumberland, and be within sight of the sea nearly all the way.

ELECTRIC SUPPLY FROM DISTANT GENERATING STATIONS.

The Vestry of Hammersmith has addressed a circular letter to each of the other local authorities throughout the Metropolis, asking for support with a view to combined action being taken in opposing certain of the recommendations of the Parliamentary Joint Committee on the Supply of Electrical Energy. These communications have, in most cases, been referred to committees for consideration and report. The specific recommendations referred to are as follow:

1. In the case of power being given for the erection of a generating station outside the area of supply, they think that powers may properly be given for laying mains in streets leading from the generating station to the boundaries of the area of supply. In such a case the local authority liable to maintain these streets should have the same option of themselves breaking up and reinstating the streets at the undertaker's expense as is now given in the provisional order to local authorities within the area of supply, and should be empowered accordingly.

2. The committee are of opinion that while it may be advisable to maintain the veto of local authorities as to the erection of overhead wires given by Section 14 of the Act of 1882, in respect of other electric wires, it is not advisable that in the case of overhead wires for traction purposes the local authority other than the London County Council and county boroughs, should have an absolute veto. While due weight should be given by the Board of Trade to the representations of local authorities the committee think that in the case of wires for the purpose of traction it would be sufficient to give a *locus standi* to such local authorities.

3. The committee consider that the provisions of the Electric Lighting Act, 1888, which requires the consent of the local authority as a condition precedent to the granting of a provisional order should be amended. In their opinion the local authority should be entitled to be heard before the Board of Trade, but should not have, so to speak, a provisional veto only to be dispensed with in special cases by the Board of Trade.

Commenting upon these recommendations the Hammersmith Vestry says:—As to the first paragraph, this Vestry is of opinion that the local authority within the area of supply should have the power of deciding the route the mains are to be laid as well as the power of themselves breaking up and reinstating the streets.

With regard to the second and third paragraphs this Vestry strongly objects thereto, and has resolved that in the event of any legislation being brought forward on the lines indicated in the paragraphs, the Vestry should take up a strong position in opposition and use every endeavour to retain its power of veto both in regard in wires for the purpose of traction and applications for provisional orders.

In conclusion, the Vestry asks for co-operation with a view to combined action being taken in the direction indicated.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1898.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, *to whom all inquiries should be addressed.*

24,508 "Improvements in electric traction." P. PINCKNEY. Dated November 21st.

24,530. "Improvements in and relating to electrical accumulators." C. T. J. OPPERMANN. Dated November 21st.

24,532. "Electric cables for high tension currents." (La Société Francaise des Cables Electriques, Systeme Berthoud, Borel & Cie., France.) Dated November 21st.

24,533. "Improvements in or relating to converting electrical energy into mechanical motion." (C. S Bradley, United States.) Dated November 21st. (*Complete.*)

24,550. "An electro-therapeutical and massage apparatus." O. SCHNEIDER. Dated November 21st.

24,559. "Improvements in electrically-propelled vehicles." H. G. MORRIS and P. G. SALOM. Dated November 21st. (*Complete.*)

24,563. "Improvements in dynamo armatures." A. C. J. GUENEE. Dated November 21st.

24,566. "Improvements in means or apparatus for opening and closing electric circuits." G. C. FRICKER. Dated November 21st.

24,570. "Improvements connected with electric batteries." W. S. RAWSON. Dated November 22nd.

24,593. "Improvements connected with the lighting of miners' and other lamps by means of an electric current." O. Y. RHODES and THE MINERS' LAMP ELECTRIC LIGHTING COMPANY, LIMITED. Dated November 22nd.

24,605. "Improvements in secondary battery plates, grids, and the like." W. H. HANSON. Dated November 22nd.

24,624. "Improvements in microphonic boxes and the like." E. HARDY and A. PICARD. Dated November 22nd.

24,641. "Improvements in secondary batteries." N. H. EDGERTON and A. H. MASTERS Dated November 22nd. (*Complete.*)

24,655. "Improvements in electric cables." E. T. GREENFIELD. Dated November 22nd. (*Complete.*)

24,708. "A new or improved instrument for interlocking railway point and signal levers with electric block or train signalling switch on double lines of railway." D. S. BURNS. Dated November 23rd. (*Complete.*)

24,714. "Improvements in or connected with trolleys for the overhead system of electric traction." R. HILL. Dated November 23rd.

24,727. "Improvements in apparatus for measuring a supply of electricity." W. A. PRICE. Dated November 23rd.

24,734. "Improvements in electric traction." P. PINCKNEY. Dated November 23rd.

24,747. "Improvements in or connected with electric sparking devices more particularly for igniting devices of motors operated by explosive mixtures." E. HOUPIED and C. V. GIRARD. Dated November 23rd. (*Complete.*) (Date applied for under Patents, &c., Act, 1883, Section 103, June 13th, 1898, being date of application in France.)

24,757. "Improved manufacture of lead plates for secondary batteries." M. WUILLOT. Dated November 23rd.

24,812. "Improvements in electrical meters." R. E. B. CROMPTON. Dated November 24th.

24,833. "Improvements in means for suspending electric motors on electrically-propelled vehicles." S. H. SHORT. Dated November 24th. (*Complete.*)

24,843. "A new or improved method of connecting shunt dynamos to the switchboards of electric generating stations." W. C. P. TAPPER. Dated November 24th.

24,855 "Method of and apparatus for electrically transmitting orders or signals suitable for use as ship's telegraph and the like." A. U ALCOCK. Dated November 24th.

24,859. "Improvements in electric sparking plugs for explosion engines or motors." F. C. SIMS Dated November 24th.

24,872. "Improvements in electric dynamos and motors." J. ATKINSON. Dated November 25th.

24,887. "An electric alarm clock specially applicable for use in public works and other institutions." T. MILLAR. Dated November 25th.

24,905. "Preparation of hydrocyanic acid and other cyanogen compounds from rhodanic acid and its salts by means of electrolysis." R. BAYER. Dated November 25th.

24,912. "Improvements in or pertaining to lamps, gas, or electric fittings and the like." C. S. BRADFORD. Dated November 25th.

24,914. "Improvements in electric current conducting hinges." F. E. CHANDLER. Dated November 25th.

24,949. "A regulating transformer for rotary phase current or polyphase current installations." SIEMENS BROS. & Co., LTD. (Siemens & Halske, Aktiengesellschaft, Germany.) Dated November 25th. (*Complete.*)

24,965. "A new or improved electrical resistance measuring instrument." G. T. HANCHETT and F. B. SAGE. Dated November 26th. (*Complete.*)

24,982. "Improvements in appliances for overhead electric traction." W. R. SMITH. Dated November 26th.

24,992. "Automatic telegraph apparatus." G. GIORGI. Dated November 26th. (*Complete.*)

25,009. "A new or improved electric arc lamp." C. VERNIER. Dated November 26th.

25,013. "Improvements in or connected with electric arc lighting." A. VOSMAER. Dated November 26th.

25,023. "Method of heating electrically-propelled tramway cars and other vehicles." O. BRENNECKE and I. TIMAR. Dated November 26th. (*Complete.*)

ELECTRICAL PATENTS OF 1884 EXPIRING IN DECEMBER, 1898.

We are informed by Messrs. W. P. Thompson & Co. that about 86 applications for patents of electrical inventions were filed in the month of December, 1884. Of these several were never completed, and of those that were, not one has been maintained to run its full length of term, viz., 14 years. One or two patents ran for 13 years, expiring last December; all the others were abandoned after the lapse of a few years.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON & Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, *price, post free,* 9d. (*in stamps*).

1897.

7,423. "Process for the extraction of pure metals or metallic alloys, and the production of carbides by electric heat." H. ASCHERMANN. Dated March 25th, 1898. Relates to electric furnaces and refers to Patent No. 859, 1897. Carbon with an oxide and a sulphide of metals having different affinities for carbon are mixed and subjected to electric heating. The metals of the oxide and sulphide are liberated, and the one with a greater affinity for carbon forms a carbide, and the other metal according as it is fixed or volatile, collects at the bottom of the matter in fusion, or in the canals by which the gas escapes. 1 claim.

1898.

12,321. "Improvements in electric batteries." E. EDWARDS. (P. A. Emanuel.) Dated May 30th, 1898. Relates to improvements in electric batteries. By heating an electrolyte and causing it to flow under pressure through the elements of a battery, and having the elements uniformly apart under all conditions, a strong and constant electromotive force is obtained. The electrolyte is discharged after passing through the battery, and between the two elements it passes through porous plates. The battery has a plurality of chambers confining the elements, and separated by porous plates. 17 claims.

12,636. "Improvements in electric switches." J. G. DIXON Dated June 6th, 1898. Relates to switches of the lever type. The contact blade attached to the lever is provided with flanges of chisel aspect, with rounded instead of flat slopes. The contacts or poles piece have bent over portions between which the flanges of the contact blade moves, and is held when the switch is operated to make contact. 1 claim.

13,682. "Improvements in electric incandescent lamps." V. SAGLIER and E. DE MARCAY. Dated June 20th, 1898. Relates to incandescent electric lamps; in the centre of the bulb is fixed a reflector of any desired kind, surrounded by the filament, so as to project and reflect the light in every direction. 2 claims.

15,812. "Improvements in telegraph printing apparatus." F. HACHMANN. Dated June 19th, 1898. Relates to telegraph printing apparatus; consists of a type wheel driven by a spring or any other arrangement. It is held against rotation by an armature which is controlled by an electro-magnet. By these and a few mechanical arrangements the message is printed on a slip of paper. 4 claims.

16,282. "Improvements in bonds or connections for the rails of electric railways." G. A. WEBER. Dated July 25th, 1898. Relates to bonds for electrically connecting the meeting ends of adjacent rails. The bond is made of copper and extends along the sides of adjacent and meeting rails, and at the joint formed by the meeting ends of the rails it is provided with an enlarged portion, so as to offer less resistance to the current when all of it has to pass through the bond. Lateral movement of the rails is provided for by an elastic packing. 4 claims.

17,380. "Improvements in drums for holding electric cables." T. OXLEY. Dated August 11th, 1898. Relates to improvements in drums for holding electric cables for purpose of carriage or transport. The barrels and flanges of the drums are made of steel or iron, and the flanges have openings approximately equal in diameter to the barrels, thus making the drums lighter. In the barrel central discs are provided, adapted to receive axles, and connected to the drum by spokes, so that the cable can be wound upon them. Handles are provided on the flanges to facilitate movement. 6 claims.